SCIENTIFIC AMERICAN

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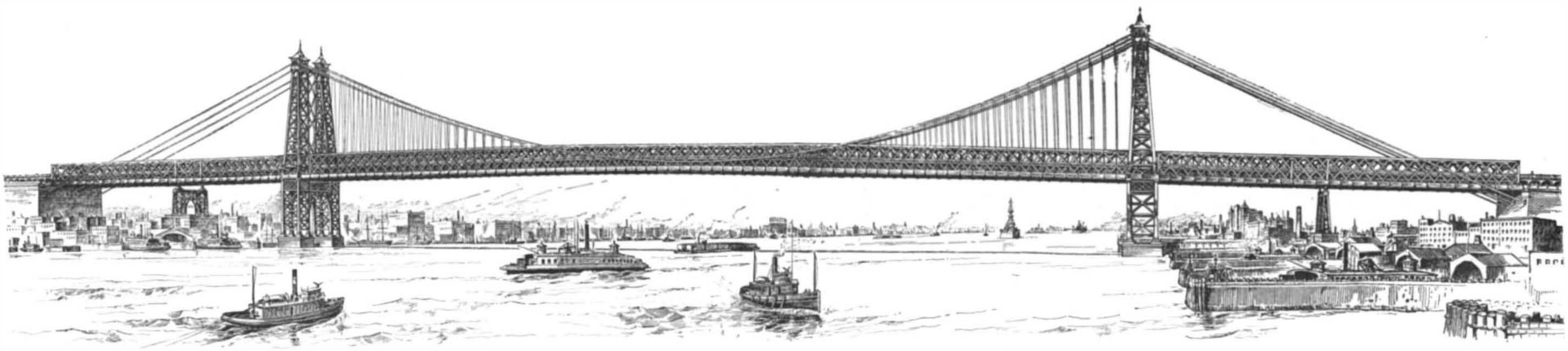
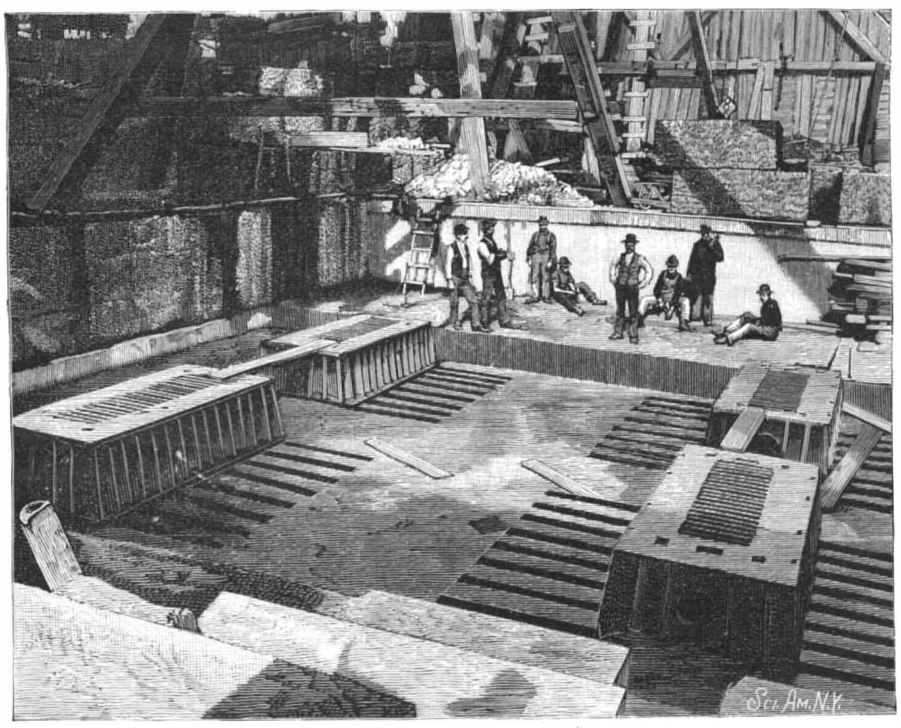
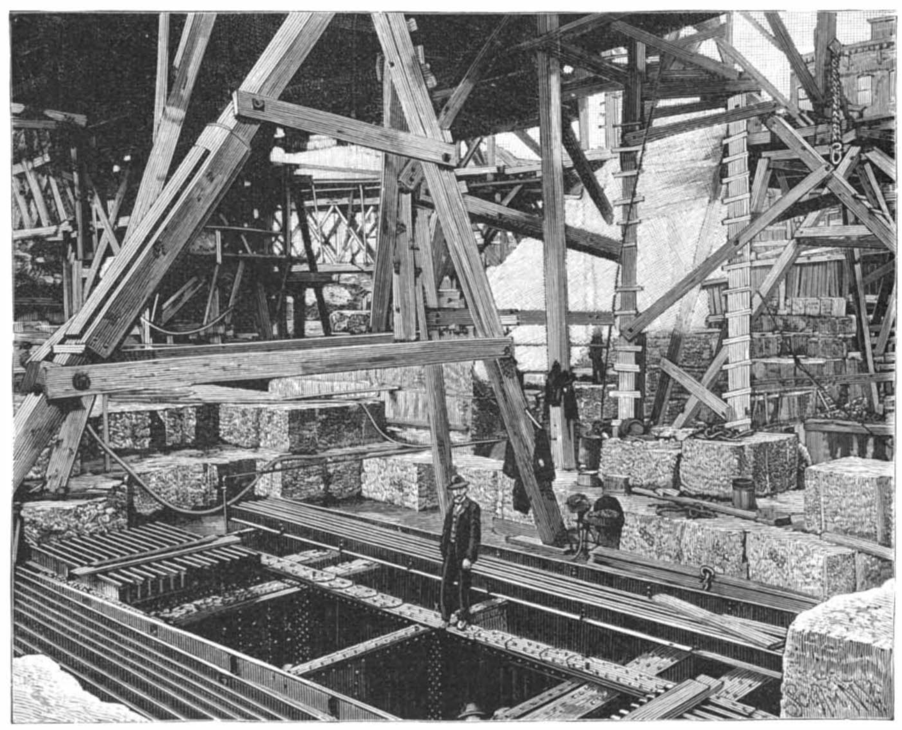


The New East River Bridge.

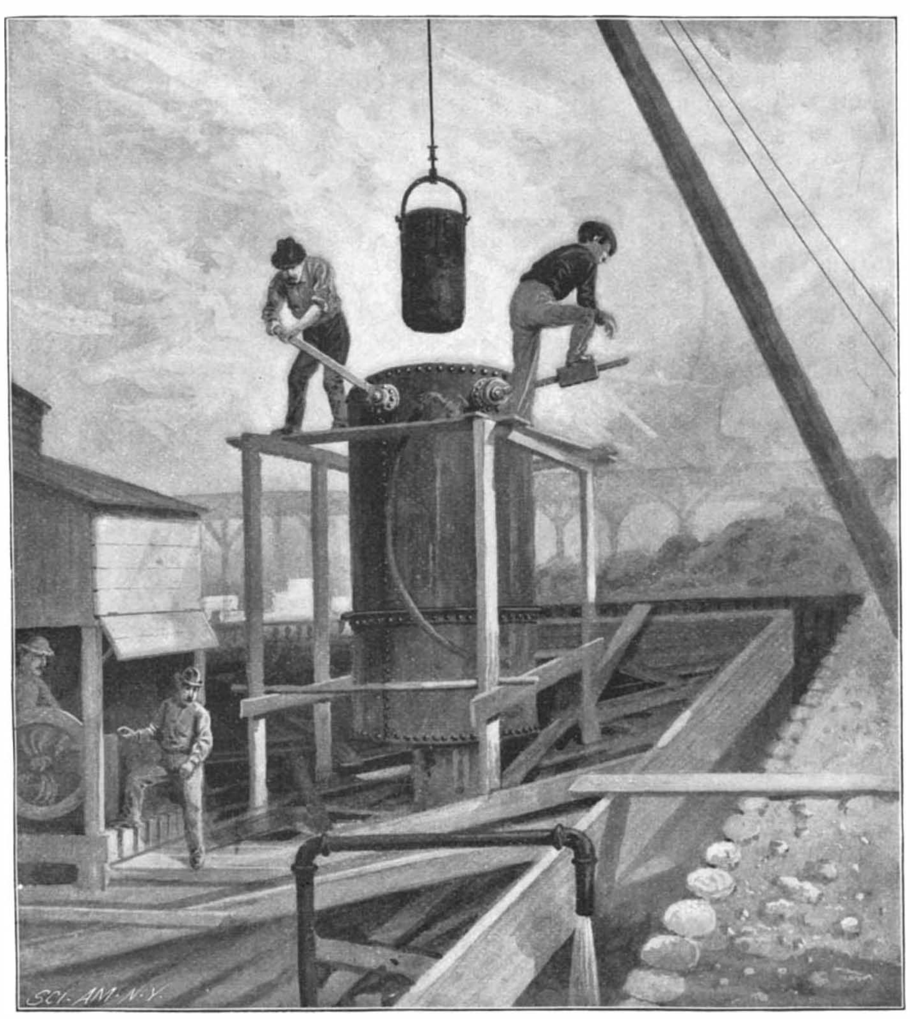
Length between terminals, 7,200 feet; length of main span, 1,600 feet; extreme width of bridge, 118 feet; height of floor above high water, 135 feet; height of cables at top of towers above high water, 332 feet.



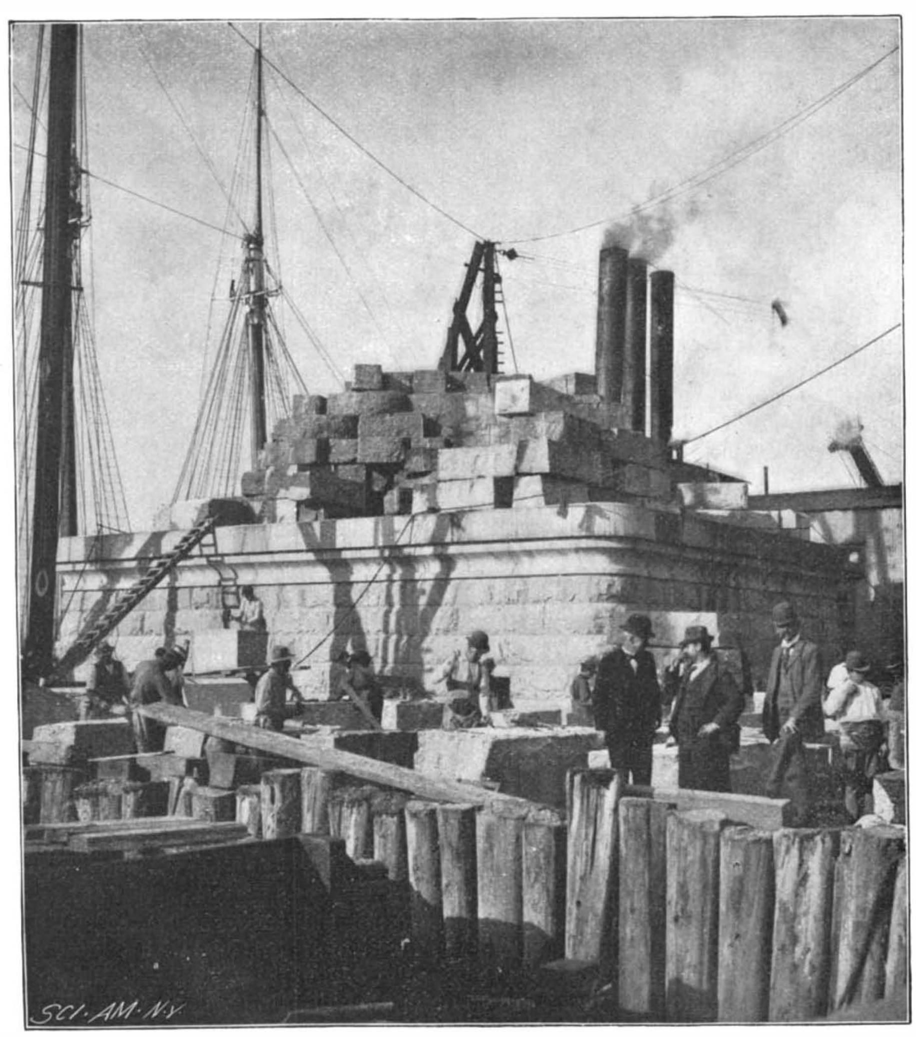
2.—Anchor Plates for Inside Cables, Before the Girders are in Place.



3.—Anchor Platform for Side Cable, with Flooring of Steel Deck Beams to Receive Masonry.



4.—Air Lock Hoist.



5.—A Completed Pier on the Brooklyn Side.

CONSTRUCTION OF THE NEW EAST RIVER BRIDGE.—[See page 10.]

Scientific American.

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NEW YORK, SATURDAY, JANUARY 7, 1899.

A RETROSPECT OF THE YEAR 1898.

The year which has now drawn to a close will go down to history as marking one of the three great epochs in the history of the United States. The year 1776 saw the birth of this Republic; in 1865 its unity was proved and declared to be forever indissoluble; and, unless the present signs miscarry, the year 1898 will mark the era of its worldwide expansion. At each crisis the guidance of the good ship of state was in the hands of men of unquestioned patriotism and integrity, who acted for a strong majority of the people. The brilliant history which records the making of this, the latest and most virile of the great peoples of the earth, proves that in 1776 and 1865 the majority was right. And what of 1898? The chief executive of the nation declared war upon Spain with the practically unanimous consent of the country, and in less than thirty days we found the widespread colonial possessions of Spain within our grasp, and the tremendous problem of worldwide empire confronting us. In the contemplation of the only alternatives of advance or retreat we have deliberately, and with, we believe, a clear sense of the grave and altogether untried responsibilities involved, decided to break away from the traditions of the past and take our stand as one of the great colonial powers of the world.

Whether this momentous step will redound to our profit or lead to our undoing will depend upon the spirit in which we enter upon our new possessions and administer their affairs. "Men at some times are masters of their fate," and the "fault . . . will not be in our stars but in ourselves" if we fail to bring peace, contentment, and prosperity to the new and strange peoples that have become subject to our administration. We believe, however, that the very magnitude of the trust imposed will impress upon Congress the necessity of abolishing so-called "politics" from our colonial affairs and administering them with a single eye to the fair name of America and the best interests of the races which we have rescued at the cost of much blood and treasure from a burdensome despotism.

By no means the least fortunate result of the war is the repairing of those bonds, "strong as steel, yet light as air," which once again unite England and America —bonds of common lineage, language, laws, religion, and feeling, the severance of which the great Burke so eloquently deplored a century and a quarter ago. The best guarantee of the depth and permanence of the present understanding is the fact that its existence is not now and probably never will be imperiled by embodying it in the terms of a formal treaty.

Brief as it was, the war served greatly to increase the prestige of our navy in respect of its discipline, personnel and material. As regards the army, it proved that the fighting qualities of the American soldier of to-day are fully up to the high standard shown on the desperate battlefields of the Civil War. Manila and Santiago take rank with Mobile Bay and the Mississippi, while San Juan and El Caney are comparable in the desperate bravery of the combatants to Antietam and the final charge at Gettysburg. If we except the monitors, our ships acquitted themselves admirably; we do not know of a single case, among the larger vessels, of absolute breakdown, and the failure of the torpedo boats was only what everyone looked for. Guns and mounts gave general satisfaction; and the breakdowns, both in ships and guns, were in matters of detail only and were easily repairable. The war has brought home to the country the absolute necessity for an increase in our naval and military forces, and it is likely that before the year is many weeks old our standing army will have been increased to 100,000 men, and a general appropriation will have been authorized for new battleships and cruisers of the most approved construction.

Next to the Spanish-American war the most notable occurrence of the year is the remarkable victory which was gained by the British forces in the Soudan. The overthrow of the Mahdist forces is a triumph of civilization over barbarism, and it brings the fairest of the equatorial provinces of Africa under the dominion of a people who have proved to be the most successful and beneficent colonizers in the history of the world. The Eastern Question has shifted from Constantinople to the far East, and has resolved itself as befits the spirit of the times from a military problem to a problem of trade and commerce. "The open door" is the watchword of that side of the controversy to which our interests and the logic of events appear to be insensibly leading us.

The new year opens auspiciously for the prospects of industry and trade, and the improvement is the more encouraging because it has been gradual and gives promise of being permanent. The most gratifying fact is the secure hold which we are obtaining upon foreign markets, as evidenced by the increasing demand for goods of American manufacture. The increase in our exports is being accompanied by a marked decrease in imports, and we are evidently fast approaching a time when we shall be absolutely independent of the European markets except in a few special and limited lines of manufacture. Very significant events in the trade between this country and Great Britain were our shipments to that country of coal and ship plates and the recent order for American locomotives. It is true the orders for coal are stated to have been due to the coal strike, and the shipment of shipbuilding material and locomotives to the inability of British manufacturers to keep up with their orders; but the ground has been broken, and it is more than likely that these orders will prove to be an open door of a permanent trade in these commodities.

Again we have to record a dearth of new construction of any magnitude in the sphere of civil engineering. The Siberian Railroad continues to be the greatest engineering project under way, and through the past year it has been pushed forward with tireless energy. This colossal work, moreover, has taken on greater significance because of its being the actual key to the Eastern Question as far as Russia is concerned. Every rail that is laid, every spike that is driven, is another link in the chain by which the Russian Empire seeks to bind the destinies of Northern China to its own. The latest estimates place the completion of the road as far off as the year 1903 to 1904. The United States are concerned more with betterments of existing railroads than the construction of new lines, although a total of 1,652 miles was added during the last fiscal year, the total length of all roads being now 184,428 miles. The largest bridge under construction is the new suspension bridge across the East River, New York, which will have a length between towers of 1,600 feet and a width of 118 feet. The foundations of the towers are all completed and the anchorages are under construction. It is likely that the stringing of the cables will commence some time in the summer or early autumn of this year. It is proposed to double the capacity of the existing New York and Brooklyn suspension bridge by double-decking the floor system and adding four supplementary cables above the present cables. It is not unlikely that another bridge will be commenced across the East River to the north of the new bridge now under construction. The year has seen the erection of a new pin-connected bridge across the St. Lawrence, at Montreal, in place of the famous tubular bridge, built nearly half a century ago by Robert Stephenson, and a handsome steel arch has also been built below Niagara Falls, replacing the old suspension bridge, the site of which it occupies. In this connection it may be mentioned that early in the present year, work will be commenced on a suspension bridge to replace the old Lewiston bridge, which was wrecked several years ago. The massive drawbridge across the Harlem River on Third Avenue, New York, which weighs 2,500 tons, has been opened for traffic, and preliminary steps have been taken toward the erection of a similar structure over the same river. The great North River suspension bridge exists as yet only on paper. Badly as it is needed, great as would be the benefit conferred, the estimated cost of $60,000,000 is evidently regarded as prohibitive. We have to record one of the most fatal bridge accidents of recent years in the fall of the new Cornwall bridge, when a river pier and two 370-foot spans fell into the river. The failure was probably due to erosion of poorly designed foundations.

Under the head of transportation there has been very little development of an abnormal character. Locomotives and trains have continued to grow in weight, and the records of one year are regularly exceeded in the next. As regularly as the prophets declare that the limit has been reached, the locomotive builders prove that it has not, by making big increases in cylinders, boilers and total weight. Early in the year the Brooks Locomotive Works produced for the Great Northern Railway a monster freight locomotive weighing 106 tons, with cylinders 21 by 34 inches and 3,280 square feet of heating surface; yet a few months later, this was exceeded by the Pittsburg locomotive of 115 tons, with cylinders 23 by 32 inches and 3,322 square feet of heating surface. The fact that practically nothing is being done in this country in the way of novel and experimental locomotives goes to prove that locomotive engineers are well satisfied that finality of type has been reached. In England there has been a revival of interest in four-cylinder locomotives, no less than four different roads having placed engines of this kind on the road. In France the Heilmann electric locomotive is still on trial, but nothing very definite has been given out regarding results. Railway speeds have remained stationary, the credit of running the fastest regular train in the world still belonging to the Philadelphia and Reading Railroad, a train from Philadelphia to Atlantic City making the run of 55½ miles at the rate of 66·6 miles an hour.

The last year has not been marked by the sensational performances in ocean transportation which characterized the preceding year. The "Kaiser Wilhelm" of the North German Lloyd has not surpassed her record of 22·35 knots an hour for the whole trip across the Atlantic, although she is said to have steamed for one whole day at an average speed of 23 knots, a feat which was about equaled by an older ship, the "Lucania," which maintained 22·9 knots for an all-day run. The "Kaiser Friedrich," which is practically a sister ship to the "Kaiser Wilhelm," and was designed to exceed the latter vessel in speed, has been somewhat of a disappointment, having failed to come within 1½ knots of the speed of the earlier vessel. The Hamburg-American line are building a 16,000 ton vessel to steam 23 knots, and the "Oceanic" of the White Star line, of 17,000 tons and 704 feet long, will be in service during the coming summer. The greatest interest at present attaches to the huge freight ships which are being constructed in increasing numbers and of ever-increasing dimensions. Several of these will draw 32 feet of water, and a strong movement is now on foot to have the government deepen the entrance channel to New York Harbor to 35 feet, so as to accommodate the expected increase which will yet take place in the draught of future ships. The year has been fruitful in disasters at sea. The shocking loss of life in the foundering of the "Bourgogne," the "Mohegan," and the "Portland," proves that with all our boasted improvements in ships and seamanship, we have yet to learn how to render ocean travel reasonably secure.

Electricity continues to assert itself as the most suitable power for city and suburban traffic. In the former it is supreme and for suburban travel it is growing in favor. The interest of the great railroad systems in the question of substituting electric for steam traction on their suburban and branch roads has not been so marked as it was in the preceding year; but experimental work in this direction is being carefully watched with a view to future developments. The success of the existing underground electric roads in London has led to proposals for the building of several other important lines of this kind. Orders for the equipment of these roads continue to find their way to this country. The most remarkable electric system at present under construction, in this country, is that of the Metropolitan Street Railway Company, in New York city. During the year underground trolley lines have been built on two of the avenues, and the well known Broadway and Lexington Avenue cable roads are being electrically equipped. The many advantages of the new motive power over the old are self-evident to the traveling public, and the underground trolley has evidently come to stay for good, or until some unthought of and better system shall take its place. Undoubtedly the most important development in transportation has been the remarkable success of the automobile carriage in this country. The horseless cab has established itself as a thoroughly practical and popular means of travel with the general public in New York, while its high speed, its ease of control, its comparative noiselessness and its convenience for use in the city in place of the two-horse carriage is rendering it increasingly popular with the wealthier classes. The electric cabs of New York are standing the test of winter work, and, during the recent snow-storms, they ran under conditions which discouraged even the horse cabs.

No record of the year would be complete without mention of the very successful Trans-Mississippi and Omaha Exposition which was held during the summer months in the flourishing Western city from which it took its name. The enterprise was conceived and carried out with characteristic Western zeal and enterprise. In thirteen months from the day on which the first spadeful of earth was turned the work of preparation was completed, and this in spite of the prevailing commercial depression. Some $2,000,000 was spent upon the grounds and buildings, and these were laid out with a landscape and architectural effect that rivaled that of the Chicago Fair. The Exposition was in every respect an unqualified success.

The record of new naval construction during the year is particularly gratifying when we bear in mind that it was carried on in spite of the severe pressure put upon our resources by the Spanish war. In the twelve months we launched no less than five first-class battleships of 11,525 tons displacement, making a total of 57,625 tons in battleships alone, thereby more than doubling the battleship force of our navy in one year's addition. The ships are the "Alabama," "Illinois," "Wisconsin," "Kearsarge," and "Kentucky;" the cruisers "Chicago," "Newark," and "Atlanta" have

been reconstructed, refitted, and rearmed, the changes making them thoroughly up-to-date vessels; and the improved plans of the new "Maine," "Ohio," and "Missouri" have been passed and the contracts let. The opening of the year finds us with eight first-class battleships, aggregating 95,125 tons, under construction for the navy, and it is gratifying to know that the whole of this work is being done in private yards. Our latest battleships of the "Maine" class will be or rather are now the most powerfully armed vessels of their class, and their speed of 18 knots is up to the present standard of other navies.

The most notable fact in connection with our ordnance is the decision to use smokeless powder exclusively in our future guns, and the proposal to make 3,000 feet per second the standard velocity for all the large rifles. Great interest also attaches to the Hobbs single-forging gun and the Gatling cast steel gun, both of which have shown good results in tests at the government proving grounds. Krupp armor still continues to hold the first place against all competitors. The government has wisely decided to adopt the Krupp system in the manufacture of its plates, and both Carnegie and the Bethlehem companies have produced plates of phenomenal endurance, the latter plate, 6 inches in thickness, having resisted the attack of six 8-inch armor-piercing projectiles without failure.

Science has again been enriched by the discoveries of Prof. Ramsay. In June of last year Ramsay was able to announce the discovery of "krypton" as one of the gaseous elements of air, the new gas being recovered from some liquid air which was being made the subject of experiment. Shortly afterward the same brilliant experimentalist, with the help of his assistant, Maurice Travers, discovered two other elements of the atmosphere, which were named respectively "neon" and "metargon." This result was made possible by the discovery, jointly, by Lord Rayleigh and Prof. Ramsay last year of argon, the new elements being obtained from a quantity of liquefied argon. Prof. Dewar, whose name is associated with the liquefaction of air, also succeeded in liquefying hydrogen at a temperature of —205 degrees Centigrade. M. and Mme. Curie report the discovery of an element which they call "polonium." It resembles bismuth, but is of far greater radiating power than uranium. Mr. Charles F. Brush announced at the Boston meeting of the American Association for the Advancement of Science that he had succeeded in eliminating from the atmosphere a gas which he calls "etherion." Its conductivity of heat is a hundred times as great as hydrogen. Sir William Crookes, in examining some rare earths used in the manufacture of the Welsbach mantle, discovered a new element, which he named "monium." It is heavier than "yttrium," but lighter than "lanthanum," its atomic weight being estimated at 118.

A notable event of the year was the production of liquid air in commercial quantities by Mr. C. E. Tripler, of New York. This is done by the development of the method of expansion in an ingeniously devised apparatus. The liquefaction is produced by the "self-intensification of cold," produced by the expansion of compressed and cooled air, no other substance being used to bring about the result. The boiling point at atmospheric pressure is —191° Centigrade, and the value of such a liquid, produced in commercial quantities, for laboratory purposes is obvious. Just how much commercial value liquid air will possess has got to be decided. Attempts are already being made to produce a liquid air motor.

In connection with our mention of Boston as the meeting place of the American Association for the Advancement of Science, it should be recorded that the past year was the golden anniversary of this well known institution, which at present boasts of a roll of 1,610 members.

The obituary of the year contains many names that will be sadly missed from the various fields of science and art in which they labored. Sir Henry Bessemer, who has had more to do with the industrial development of the nineteenth century than any other man, died on March 14. At the time the fiftieth anniversary number of the SCIENTIFIC AMERICAN was published, the readers of our journal put themselves on record as considering that the Bessemer process was the greatest invention of the last fifty years.

Dr. John Hopkinson was another Englishman whose death leaves a considerable gap in the front ranks of science. There is scarcely a branch of electrical work that does not owe something to his thought and labors. His improvement of the Edison dynamo, and his three-wire patent, which he disposed of to the Westinghouse Company for $100,000, are among his well-known achievements.

The death of Colonel George E. Waring, Jr., is lamented, not alone in the United States, his native land, but in every part of the civilized world where his writings have made him known. This soldier-engineer was distinguished by his work in many fields of industry and occupation; but his most brilliant success was achieved in recovering New York city from the disreputable state of filth in which Tammany corruption had permitted it to lie, and systematizing a street cleaning force which was a model of system and efficiency. He is to be reckoned as one of the martyrs of the war, having contracted yellow fever during his inspection of Havana with a view to its sanitation.

The death of Latimer Clark has reduced the number of those who are connected with the earlier development of land and submarine telegraphy. Together with his partner, Sir Charles Bright, he acted as engineer in the making and laying of the second and third Atlantic cables, and in all his firm was connected with the laying of 60,000 miles of submarine cables.

Prof. James Hall was a scientist whose death was noted with regret, not only in his native land, but in the many foreign countries where he was honorably known. He was the State Geologist of New York for sixty-one years, and one of the most industrious men in an industrious age. Although he died at the age of eighty-seven, he was able during the last ten years of his life to write 250 papers on scientific subjects. His life work was paleontological study.

In the lamented death of Joshua Rose, who was one of the editors of Appleton's "Cyclopedia of Applied Mechanics," "Modern Steam Engines," "Modern Machine Shop Practice," and numerous other well known works, the SCIENTIFIC AMERICAN lost one of its early contributors. Mr. Rose was an accomplished writer and a voluminous contributor to the technical press.

We close our review of the year with mention of another distinguished engineer among those we have mentioned as having passed away—Sir John Fowler, perhaps best known for his work as the designer of the great Forth Bridge in Scotland. His work covered almost every branch of engineering, for much of it was done in the earlier half of the century when specialization had not been carried to the extent which characterizes the present day.

REMARKABLE USES OF PEAT.

BY OLIVER C. FARRINGTON.

One of the most interesting and attractive exhibits at the Vienna Exposition of last year was a building containing the most diverse articles made from peat. Everything in the building, from the carpets on the floor to the curtains at the windows and the paper on the wall, had been made from peat. These were but representatives of what will undoubtedly soon become a great industry and give to the peat bogs of the world a value never before dreamed of.

Credit for the discovery of the possibilities of peat belongs chiefly to a Vienna gentleman, Herr Karl A. Zschörner. His investigations into its nature began some twelve years ago with a study by means of the microscope of what is called in Austria "torfstreu." This is the layer of moss which covers the surface of most peat bogs. It has hitherto, by those who have made use of the peat for fuel, been at considerable expense removed and thrown away. Herr Zschörner's examination showed that the plant remains which make up this layer abound in hollow, spiral cells. These absorb water and other fluids with great avidity. While ordinary straw cannot absorb over four times its weight of fluids, this peat straw will absorb ten times its weight. The peat straw, moreover, possesses the antiseptic and disinfectant qualities of peat, qualities which have long been known, but of which little use has been made. Herr Zschörner accordingly hit upon the idea of drying the straw and using it as an absorbent in stables, breweries, and various manufactories. For such purposes it proved most admirably adapted, and the demand for the product soon grew large. Having greater absorptive power than ordinary straw, the peat straw can be used much longer in any given place and yet will have proportionally greater manurial value. It gives a healthy, resilient footing also for animals. For packing of both perishable and breakable articles it is also better than ordinary straw, since it is more elastic and less easily penetrated by heat and cold. Another form of peat which was found to be a better absorbent for some places was the peat itself, dried and ground to a powder. This is especially adapted for use in earth closets and about sinks and drains, its absorbent power and disinfectant properties making it admirably adapted for these uses.

Herr Zschörner did not rest his investigations here. A further study of the peat itself showed that it was very largely made up of fibers. These fibers come from the remains of reeds and grasses, which, growing and dying in successive generations, form the peat. In their submergence the reeds and grasses suffered no anatomical change, but their physical and chemical character became entirely different. The organic substance of the plant became inorganic, so that nothing capable of fermentation or decay was left, while the fibrous structure remained intact. These fibers then were found to have unusual physical properties. They were found to be very durable, very elastic, to be non-conductors of heat and non-combustible.

If a fabric could be woven from them, it would be one possessing unique properties. To the toughness of linen it would add the warmth of wool, an absorbent power greater than that of cotton, and the indestructibility of asbestos. It must, however, be woven without the aid of oils or water, or much of its value would be lost.

After twelve years of experimenting, Herr Zschörner succeeded in making the peat fibers weavable. There is now, therefore, scarcely any textile article which cannot be made from peat. Coats, hats, carpets, rugs, ropes, matting, and pillows are some of the articles which have been made, and have been found useful. What superiority these will prove to have in practice over fabrics made from other fibers, only time will tell. Some of them have, however, already been proved to be immensely superior to any other fabrics. This is especially true of the blankets and other coverings used for horses and cattle, for they greatly excel in warmth, absorbent power, cleanliness, and durability. The unspun fiber promises to be a valuable substitute for absorbent cotton, since it will not only absorb a much greater quantity of blood and other fluids than cotton, but it possesses powerful antiseptic properties as well. The coarser fiber it is expected will come into favor for use in upholstery work, its extraordinary elasticity making it most valuable for this purpose.

The latest achievement of the discoverer of the uses of peat has been the making of paper from its fiber. This has been carried to such an extent that paper of almost every variety of weight and quality can be made, while the toughness and durability of each is equal to that of paper from any kind of vegetable pulp. The above are but a few of the uses to which this remarkable fiber can be put, but they indicate possibilities which may yet rank peat bogs among the most valuable of the world's resources.

AUTOMOBILES FOR FIFTH AVENUE.

For many years the last relic in the way of stage lines in New York has been the Fifth Avenue line, but the service has not been very satisfactory to the public and the franchise has now been acquired by the Third Avenue Railway Company. This line will be equipped in a short time with automobile carriages of some kind. If this is done, the line will be a valuable feeder to the various crosstown lines owned or leased by the Third Avenue Railway Company. The present service is slow and irregular, and for a long time the stage company had been examining various methods of traction. It is not probable that tracks can ever be laid in any part of Fifth Avenue, as public opinion as well as property holders are entirely opposed to it.

There is no objection, however, to the noiseless and cleanly horseless omnibus or stage, which will leave the street in a good sanitary condition. Of course, the Fifth Avenue line of stages must necessarily compete with the Madison and Fourth Avenue electric lines, and for a long distance it runs parallel with them; but while automobile vehicles cannot be operated as cheaply as the underground trolley, still the margin of difference is not so great as to prohibit their use, and, as we have already stated, the line would be valuable as a feeder to the various crosstown lines. There are many people who have used the stage line for years and who will probably continue to do so, and from a scenic point of view nothing can be finer than a ride up Fifth Avenue in a modern omnibus. There is no crush of travel as there is on many of the adjacent streets, so that the trip is more enjoyable, and the line will certainly come in for a considerable percentage of the "short haul" business, which pays very well and it is admirably adapted for this kind of transportation.

During the storm on November 26, the electric automobile vehicles behaved remarkably well. They ran throughout the entire night, and the last one only came in about six o'clock in the morning, when the snow must have been from eight to ten inches deep, and the carriages had no difficulty whatever in forcing their way through drifts which were much deeper than this. Horse cab companies turned over orders to the electric company rather than fill them themselves. Of course, the mileage per charge of battery was reduced. The motors and batteries acted admirably. One reason of their success was undoubtedly due to the large pneumatic tube tires, which are five inches in diameter and give a large and resilient bearing surface.

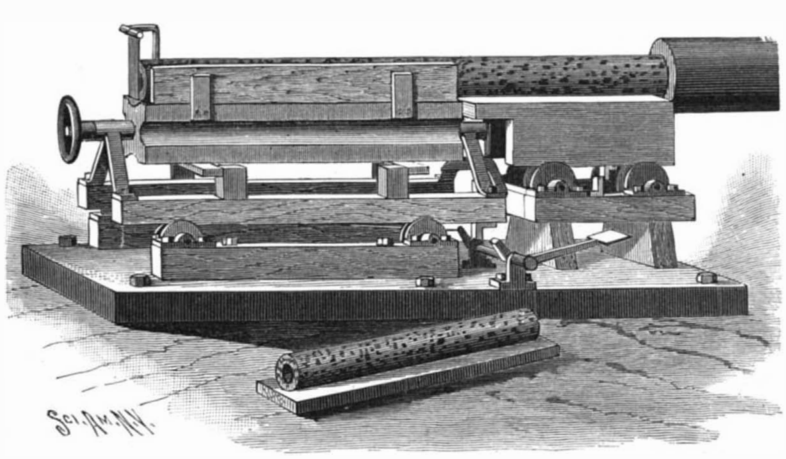
A BURNISHED finish on the journals of axles for railway carriages and locomotives has given good service, and has been used on many roads for a long time, says The American Engineer. The advantage of it is to smooth the surface of the journal after the finishing cut, and to shorten the period of breaking in. The burnishing is done by three rollers carried on a tool rest and bearing against the journal, considerable pressure being obtained by a screw. The rest is fed along so that the finishing cut and the burnishing are done at the same time. Mr. Atkinson, of the Canadian Pacific, uses the burnisher on piston rods, and intends to use it on valve rods, as well as on journals. He stated, at the recent Master Mechanics' Convention, that it gave the best finish that he knew of for piston rods.

AN IMPROVEMENT IN CLAY-CUTTING TABLES.

It has hitherto been possible only with costly and complex machinery, to cut clay and other plastic material, into any desired length. It is the purpose of an invention recently patented by Arphad Snell, of Tice, Ill., to obviate this difficulty by providing an inexpensive machine which is of simple construction, which can cut clay into any length, and which so delivers the material that it can be safely carried to a baking oven.

The machine comprises essentially a table made in two sections mounted upon flanged guide-rollers, one section being capable of end movement only, and the other section of both end and rotary movements. The rotary section has a number of grooved receiving faces; a hand-wheel, through the medium of which the faces may be revolved; and an adjustable gage. On the receiving faces, extensions are carried which support a board upon which the moulded clay is carried away. Stop devices on both sections of the table limit the end movement of the sections.

When it is desired to use the table, the section having end movement only, is carried as close as possible to the delivery end of the mold; and the inner end of the rotary section is shifted as close as possible to the first-named section, the parts being held in this position by the operator's pressing on a foot-lever controlling the stop-devices of the rotary section. After the outer end of the molded clay has reached the gage, both sections of the table are allowed to travel on their rollers, until the stops on the sections having end movement only, limit the movement of that section. The molded clay is then cut by hand at the point where the two table-sections meet, whereupon the rotary section is turned by means of the hand-wheel, and the clay deposited upon a board previously placed in position against the extensions on the upper receiving face of the rotary section. Another board is then placed in position; the two sections of the table are returned to their original position; and the operation is repeated. The apparatus is particularly designed to cut clay into lengths suitable for fence-posts. The material, it will be observed, can be cut and discharged without interrupting the molding process or the delivery of the material.



SNELL'S CLAY-CUTTING TABLE.

The Eclipse of the Moon.

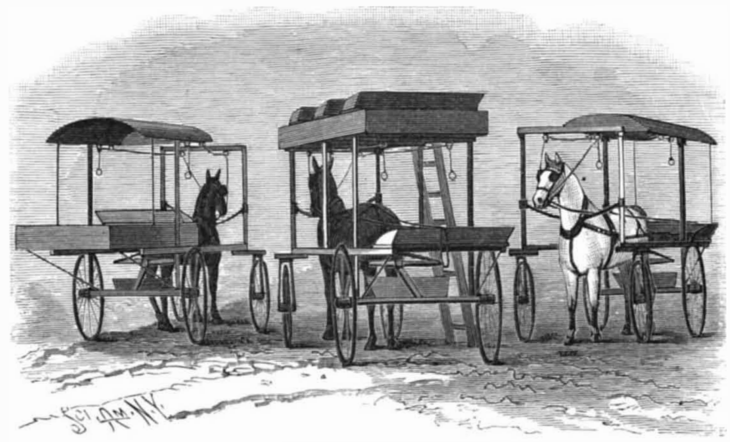
The total eclipse of the moon on December 27 was viewed with considerable success at the United States Naval Observatory at Washington. Owing to partial cloudiness, several of the occultations could not be observed. The moon was scheduled to enter the shadow at 4:57 o'clock and the totality to begin exactly one hour later. The actual time was a few seconds later. According to the arrangement made by the Observatory at Pulkowa, Russia, one hundred and three occultations were to be observed in different parts of the world and twenty-one were assigned to the National Observatory at Washington. Seventeen of the twenty-one occultations were observed and the rest were obscured by clouds. The scientific value of the eclipse will be chiefly verifying the knowledge which has already been obtained by other methods regarding the same diameter of the moon. Observations were also made at New Haven, Conn., at Columbia, by Prof. Rees, and at Princeton, N. J., by Prof. Young.

The eclipse was viewed with great success in Berlin at the Treptow Observatory by Prof. Archenhold, who photographed it in all its phases. At Berlin the moon entered into totality at a quarter to twelve o'clock, when the colors became brighter than previously. It was first a dark brown with a streak of yellow; next a reddish brown, and lastly a beautiful combination of colors, as though pierced by the rays of the sun. The silver-white line then kept spreading, and at twenty-five minutes past twelve it was at the maximum. In every phase the delineation of the moon was visible; that of the shadow of the earth was much less clear. It is stated that Mars became very red during the period, becoming more intense according to the color assumed by the earth's shadows.

A CONVERTIBLE VEHICLE.

In the annexed illustration, we present a vehicle having a wheeled frame within which the horse is harnessed, the frame being provided with removable parts by means of which the vehicle may be converted into a coach, buggy, or wagon.

The frame has two horizontal side bars, upon each of which standards are mounted at the front and rear. The rear standards project below the side bars, and receive the rear axle of the vehicle. At the lower portions of the front standards, forks are mounted to turn, between which forks the front wheels are carried. Vertical spindles on the forks move in slotted casings at the lower ends of the front standards, and are engaged by arms having movement relative to the forks and held in place by pins. Should the frame be slued laterally at its front end, by the pressure of the horse on the frame, the front wheels will be slued in a corresponding direction. By arranging the parts of the frame in various ways, it is possible to transform the vehicle into a buggy, a coach, or a light wagon, as shown respectively to the right, center, and left of the accompanying engraving. When used as a coach, the vehicle is provided at the top with seats, to which the passengers may ascend by means of a folding ladder. When the vehicle is used as a buggy, or as a wagon, the seats and the intermediate standards are removed, and the front standards rigidly braced by crosspieces. In order that the horse may be readily enabled to slue the frame to the right or to the left, under the action of the reins, the inventor employs a strap passing from the horse's collar to the front standards. Check reins secured to the bridle of the horse, are reeved through rings carried by the body of the vehicle. The vehicle is the invention of Thomas J. Cox, Enon, Ala.



A CONVERTIBLE VEHICLE.

The Weather Bureau in Cuba.

The Secretary of Agriculture has directed the Chief of the Weather Bureau to move the headquarters of the present West Indian storm warning service from Kingston to Havana, to establish complete meteorological stations at Cienfuegos and Port au Principe, and as rapidly as possible to extend the climate and crops service of the Weather Bureau over the island, so that within a period of not more than two months complete information can be given of anything meteorological and agricultural in various parts of the island, and reports will be made as to the progress of the rehabilitation of the industries which during the recent strife were either suspended or completely annihilated. The Secretary of War has been requested to assign buildings and grounds for the headquarters of the service in Havana. The cost of the entire United States Weather Service in the West Indies, including observatories on the north coast of South America, will probably be much less than was expended by Spain in maintaining inefficient and almost useless meteorological service over the island of Cuba.

Some months ago the Chief of the Weather Bureau began the establishment of a complete climate and crop service in the island of Porto Rico. The Weather Bureau system of gathering crop and meteorological reports has now been so well extended throughout the island that it is thought by the first week in January a full crop report showing the conditions of the crops in all of the provinces of the island will be published for the benefit of interested parties in the island and in the United States, and this service will be continued weekly.

How Santiago Was Cleaned.

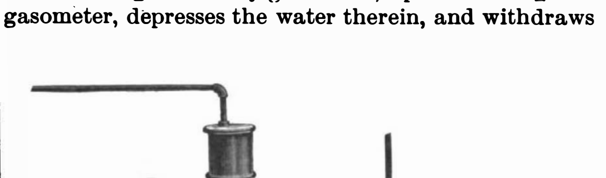
Robert P. Porter, special commissioner for the United States to Cuba and Porto Rico, in his report to the Secretary of the Treasury, tells what he saw in recent visits to those islands. Speaking of improvements made at Santiago, Mr. Porter states that the disagreeable smells of the typical Cuban city are less pronounced in Santiago, while whitewash, limewash, fresh paint, and all sorts of disinfectants have deodorized the surrounding atmosphere and made the old town quite habitable. The streets are no longer used as sewers, and the unhappy individual who may violate the law and who escapes the lash of the sanitary commissioner's whip is compelled to work on the street for thirty days. Sanitary Commissioner Barbour has under him one hundred and twenty-six men dressed in spotless white and thirty-two mule teams and carts. This force of men have dug out from the streets the filth of ages, and they are now kept absolutely clean. By the aid of petroleum the garbage of the day is burned. The work of sanitation is not confined to the streets, but extends to the dwelling houses and other buildings. In many cases the doors of houses had to be smashed in and the people making sewers of the thoroughfares were publicly horsewhipped in the streets. These measures were drastic, but were entirely warranted by the flagrant carelessness of the people. Some of the most respectable citizens were haled before the commanding general and sentenced to aid in cleaning the streets they were in the habit of defiling. The campaign has resulted in a complete surrender to the sanitary authorities, and the inhabitants of Santiago have had their first object lesson in the new order of things which came with the close of the war.

AN AUTOMATIC ACETYLENE-APPARATUS.

An acetylene gas-generator has recently been patented by Milton D. Keiser, of Mitchellville, Iowa, in which the gasometer, coacting with a water-filled pressure-tank, is made to flood the generating-chamber according to the volume of gas required.

The apparatus comprises essentially a large pressure-tank containing water, and a smaller gasometer-tank connected with generating-chambers. Both tanks communicate with each other and with a common blow-off chamber. A pipe leading from the gasometer to the bottoms of the generating-chambers supplies the carbide with water. The gas formed rises and is conducted to the gasometer by a pipe leading from the generating-chambers. Within each generating-chamber two or more perforated carbide buckets are placed, one above the other, the purpose of this arrangement being to prevent the simultaneous contact of the water with all the carbide, as well as to prevent the contact of the decomposed carbide with that which has not yet been acted upon.

The gas generated by the carbide passes into the gasometer, and is then distributed by a service-pipe. As the gasometer and carbide-chamber communicate with each other, the pressure in both must be the same. When the volume of gas in the generator decreases, the water from the pressure-tank causes the water in the gasometer to rise and to force the water in the bottom of the generating-chambers into contact with the carbide. The gas thereby generated, upon entering the gasometer, depresses the water therein, and withdraws the water from the carbide, thus stopping the further generation of gas. By these means the apparatus acts automatically to regulate the generation of gas. The pressure-tank coacts with the gasometer to control the gas-pressure. Should the pressure become excessive, the surplus gas is blown off by means of the blow-off chamber and vent pipes.



KEISER'S AUTOMATIC ACETYLENE-APPARATUS.

THE GIANT WHEEL OF PARIS.

The newspapers recently informed us that a trial of the gigantic wheel had been made in the presence of M. Blanc, prefect of police.. An emulator of the 300 meter tower erected upon the Champ de Mars, this apparatus is commonly styled the "Great Wheel of Paris." It stands on Avenue de Suffern, opposite the celebrated gallery of machines of the Exposition of 1889. The idea of such a construction is due to Mr. Graydon, an officer of marines of the United States navy, who took out a patent for it in 1893. The present project emanates from an English society. The operation of mounting took place under the direction of Mr. Slitkins, an English engineer. The general work of construction, the installation of the material necessary to revolve it, and the lighting of it were confided to Mr. W. B. Basset. The first wheel of this kind was constructed for the Chicago Exhibition, but it did not attain the dimensions of the one under consideration.

The metal entering into the structure of the French wheel is steel, furnished by the Société des Forges et Acieries de Haumont (Nord). The weight of the metal employed is no less than 800 tons.

The wheel is designed to revolve around a horizontal axis situated at 220 feet above the level of the ground, and moving in two bearings that rest, through the intermedium of a heavy oak beam, upon two frames. At its periphery there is a series of cars that are carried along in the rotary motion of the apparatus.

The diameter of the wheel is exactly 93 meters (305 feet). At the lowest level to which the cars can descend they will be 10 feet above ground, and the highest point that they will reach will consequently be 315 feet above the surface. Between the two external fellies are suspended a certain number of cars designed to be used as saloons, parlors, dining saloons, reading rooms, concert halls, etc.

The total weight of the wheel, inclusive of the empty cars and exclusive of the axis and frames, is 1,430,000 pounds. The axis weighs 79,200 pounds and the two frames 873,400. The total weight of this architectural monument is, therefore, 2,382,600 pounds. Each car is capable of accommodating 30 persons, and the number of cars is 40. Supposing the average weight of each passenger to be 154 pounds, the total load upon the foundation will be 1,167 tons.

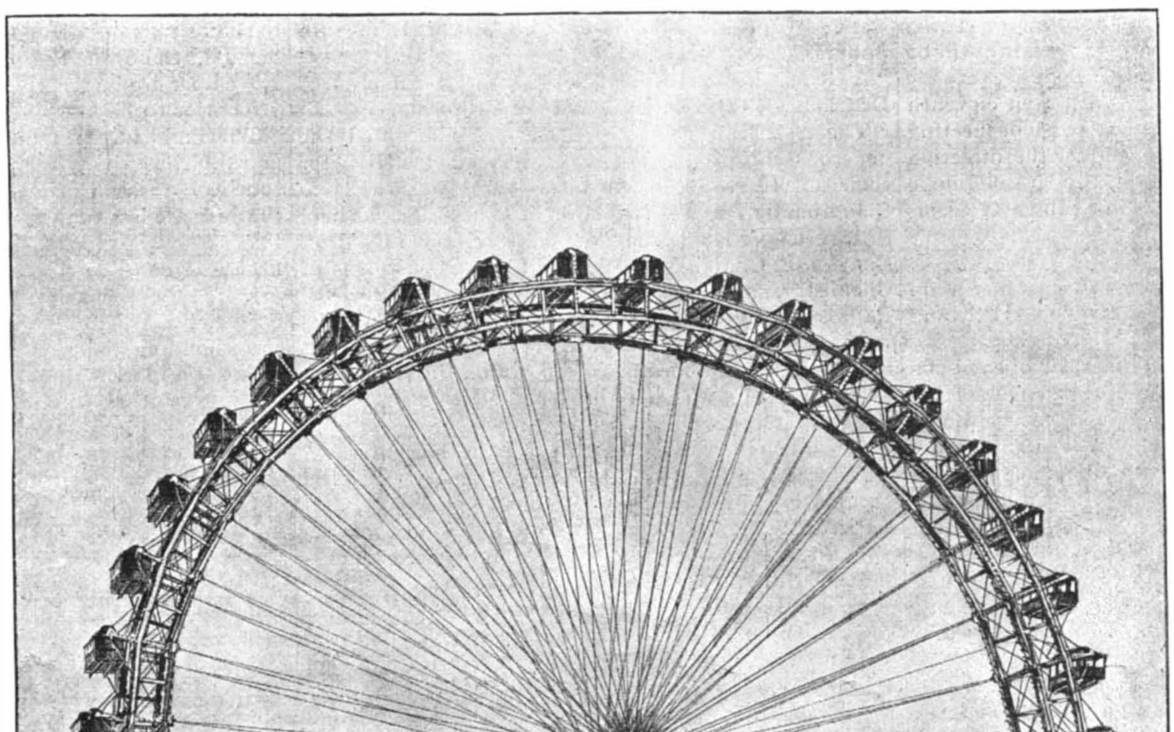
The foundation is of concrete made of Portland cement. Two excavations, 18 feet square and 39 feet deep, were made in the earth and were filled with a mixture of sand, pebbles, and pure cement without the addition of any hydraulic lime. Each of the monoliths thus formed has a weight of 230 tons. It is upon these beds that rest the two steel frames that support the wheel. Each of these frames consists of four lattice girders connected by heavy steel cross braces and diagonal tie beams. They were mounted in detached pieces that were bolted and riveted together.

The axis, which is of first quality Martin steel manufactured in England, is a heavy hollow piece about 50 feet in length and of an external diameter of 36 inches.

The shaft revolves in steel bearings lined with a metal of peculiar composition—a mixture of lead, tin, and various other substances. This alloy is designed to prevent the friction of steel upon steel, the coefficient of which is very high. From each side of the axis radiate 160 flexible cables of steel wire 2 inches in diameter, which are attached to the fellies of the wheel and are provided with stretchers for stiffening them after being put in place. The rotary motion of the wheel is obtained through a double cable, which embraces it and winds around windlasses actuated by a 120 horse power steam engine. The security of the operation of the apparatus is assured by several instantaneously acting brakes, which also control its motion. The engine also runs a dynamo, the current of which will supply arc and incandescent lamps.

The electric communications, starting from the ground, are effected through cables that follow one of the frames and end at the axis. From this point the current is transmitted to the periphery by cables, and to the different posts of electric distribution by circular plates and contact brushes. The processes of illuminating every part of this huge structure furnish a means of obtaining all the plays of light desirable. As the wheel revolves, the shining of the lamps in space will give it the aspect of a piece of fireworks. The wheel makes one revolution in twenty minutes, inclusive of stoppages. Access to the cars is obtained through a system of stairways and landings so arranged that eight cars can be filled and emptied simultaneously, without any blockade, in less than one minute. Each car is 42½ feet in length.

For the above particulars and the illustration we are indebted to the Encyclopédie du Siècle.



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THE GIANT WHEEL OF PARIS.

A New Chemical Element.

Dr. Becquerel has announced to the Academy of Sciences at Paris the discovery of a new supposedly elementary substance which has a close affinity to barium. The correspondent of The New York Sun who cables the news states that its discoverers, MM. Curie and Bremona, have named it "radium." It is so sensitive to light that it will take photographic impressions.

Great Consumption of Quinine in America.

It is estimated that, during and since the war with Spain, over 125,000,000 grains of quinia have been issued to American soldiers suffering with fever. In some cases men who were in the hospitals were dosed with as much as 300 grains per week, and almost every man in the army took the drug at some period of his service, either for its curative or preventive effect. Yet, as large as these figures are, they are hardly as surprising as those for the entire population of the United States. We are a race of quinine eaters, and the people of this country consume one-third of the quinine of the world. Although such doses as prevailed in Cuba and Porto Rico are seldom taken in the States, there are few people here who do not at some time during the year take quinine in some form or other. The drug is used in the preparation of many patent medicines, tonics, bitters, cold cures, etc.; even in hair tonic for external application. The official figures of the Treasury Department show that last year there were imported into the United States 1,539,056,750 grains of quinia. This means a consumption of something like 20 grains for every man, woman, and child, as there were practically no exports of this article.

The cinchona tree, which furnishes quinine, Peruvian bark, and calisaya bark, is a native of the western South American coast countries, more particularly Peru; yet but a comparatively small portion of the world's product now comes from that region. For many years all the quinine of commerce came from the wild trees of Peru, but with the present great demand, the refined product obtained from the wild trees of its native habitat would supply but a small proportion of the world's requirements. At the present time two-thirds of the quinine used is produced in Java, an island of the East Indian archipelago, corresponding closely in size to Cuba, and having with it many features of soil and climate in common. The history of cinchona culture in Java is interesting. For thirty years the Dutch government, which owns Java, was urged to undertake in the island the introduction of this plant from Peru, and finally, in 1852, it employed the botanist Hassharl to explore the cinchona forests of Peru. He procured a large number of varieties and took them to Java, where plantations were started, which have succeeded to the extent already indicated. The government of India was not to be behind in this matter, and the cinchona plantations and factories of that region produce now their share of this important drug. The importance of sending trained explorers to find and import new and rare plants is shown in the early efforts of the Indian government to secure cinchona trees. Seven years of governmental correspondence failed to secure a single living plant of this species, when the government engaged Clement R. Markham to visit the mountains of Peru, at the risk of his life, and he succeeded in establishing in the British East Indies in a single year 9,732 cinchona trees.

The price of quinine has, of late years, steadily decreased, so that now it is considered a cheap drug. In 1897 the import price in the United States was a little over sixteen cents per ounce. When it is considered that an ounce avoirdupois contains 437½ grains, it is seen that the quinine in a dozen 2-grain capsules does not cost much. The total value of refined quinine and cinchona bark imported into the United States last year was $725,457.

Meetings of Scientific Societies in New York.

Five of the eleven scientific societies which met in New York during the holidays for their winter meeting held their sessions December 28 in the halls of Columbia University, while others met at the College of Physicians and Surgeons and other places. Prof. W. J. McGee delivered an interesting address before the Anthropological section of the American Association for the Advancement of Science. Perhaps the most exhaustive philosophical paper of the section was presented by Major J. W. Powell, Director of the Bureau of American Ethnology. Major Powell's subject was "Aesthetology, the Science of the Senses." Mr. James Mooney, of the Bureau of Ethnology, gave an account of the Indian Congress at Omaha during the Trans-Mississippi Exposition. From an ethnological point of view, he said, the congress was not what was expected. There were twenty tribes and twenty-five languages represented, but most of them were Indians of the plains. Several other papers were presented and the section adjourned. The next meeting will be held in Columbus, Ohio.

The American Folk Lore Society held their eleventh annual meeting in Fayerweather Hall. The meeting was enlivened with Indian songs under the direction of Alice C. Fletcher and others. The graphophone was used to present an Omaha war song. It seems that the modern talking machine is of considerable use to folk lorists. Prof. Henry Wood, of Baltimore, President of this Society, delivered an address on "Folk Lore and Metaphor in Literary Style," and other papers were presented.

The Geological Society of America opened its eleventh annual meeting on December 28 in the large lecture room of Schermerhorn Hall and was welcomed to the University by President Low. Prof. J. J. Stevenson, of the New York University, President of the Society, presided, and after the transaction of business, the vote for officers for the ensuing year was announced. The following were elected: President, Benjamin K. Emerson, Amherst, Mass.; First Vice President, George M. Dawson, Ottawa, Ont.; Second Vice President, Charles D. Walcott, Washington, D. C.; Secretary, H. L. Fairchild, Rochester, N. Y.; Treasurer, I. C. White, Morgantown, W. Va.; Editor, J. Stanley-Brown, Washington, D. C.; Librarian, H. P. Cushing, Cleveland, O.; Councilors, W. M. Davis, Cambridge, Mass., and Joseph A. Holmes, Chapel Hill, N. C.

A memorial of the late Prof. James Hall was read by Prof. Stevenson, who then proceeded to deliver the President's annual address to the society.

A large number of papers were read on this and ensuing days. The annual dinner took place on Thursday, December 29.

In the rooms of the Department of Psychology, Schermerhorn Hall, the American Psychological Society opened its seventh annual meeting and proceeded at once with the reading of papers, Prof. Hugo Muensterberg, of Harvard, presiding. The papers presented were, in part, as follows: "The Development of Voluntary Movement," E. A. Kirkpatrick; "Report on the Effects of Cannabis Indica," Prof. E. B. Delabarre; "Certain Hindrances to the Progress of Psychology in America," Prof. George T. Ladd; "Reason a Mode of Instinct," Henry Rutgers Marshall; "Nature of Animal Intelligence and How to Study It," Prof. Wesley Mills; "Psychological Classification," Miss Mary Whiton Calkins. Prof. Hugo Muensterberg, the President of the association, delivered the annual address, taking as his subject, "Psychology and History." An interesting discussion on the "Relations of Will to Belief" was arranged for.

In the same building the Society of Plant Morphology and Physiology also held their session, and, after a brief business meeting, the reading of papers was begun. Papers were presented by Dr. W. W. Rowlee, of Cornell University; Dr. J. W. Harshberger, of the University of Pennsylvania; Dr. W. F. Ganing, of Smith College; Prof. B. D. Halsted, of the New Jersey Agricultural College; F. E. Lloyd, of the Teachers' College; Charles H. Shaw, of the University of Pennsylvania; R. E. B. McKenny, of the University of Pennsylvania; Miss Amelia B. Smith, of the University of Pennsylvania; Dr. M. A. Howe, of Columbia University; Dr. Henry Kraemer, of the Philadelphia College of Pharmacy.

The American Morphological Society met in the zoological lecture room. Prof. Henry F. Osborn, of Columbia University, presided. Among the papers read were: W. Patten, "Gaskell's Theory of the Origin of Vertebrates from Crustaceans;" Rashford Dean, "Notes on Myxinoid Development;" F. B. Sumner, "Notes on the Early Development of the Catfish;" J. Reighard, "On the Development of the Adhesive Organ of Amia;" W. E. Ritter, "On the Reproductive Habits and Development of the California Land Salamander, Autodax" (presented by G. H. Parker); C. H. Minot, (1) "Notes on Mammalian Embryology," (2) "Prof. O. Van der Stricht's Researches on the Human Ovum, the Nervous System of Amphioxus, and the Development of Thysanozoon," with demonstrations; S. P. Gage, "Notes on the Morphology of the Chick's Brain;" W. A. Locy, "Review of Recent Evidence on the Segmentation of the Primitive Vertebrate Brain;" C. J. Herrick, "Metameric Value of the Sensory Components of the Cranial Nerves;" W. A. Locy, "New Facts Regarding the Development of the Olfactory Nerve;" N. R. Harrington and E. Leaming, "Action of Different Colors upon Protoplasmic Flow of Amoeba."

The eleventh annual meeting of the American Physiological Society also took place in the physiological laboratory and a number of papers were presented.

The annual meeting of the American Mathematical Society was held in Fayerweather Hall in the lecture room of the Department of Physics. Among the papers presented were the following:

"On Multiple Resonance," Prof. M. I. Pupin, Columbia University; "On the Development of the Perturbative Function in Terms of the Eccentric Anomalies," Dr. A. S. Chessin, New York; "On Some Points of the Theory of Functions," Dr. A. S. Chessin, New York; "On the Transformation of Straight Lines into Spheres," Prof. E. O. Lovett, Princeton University; "A Generalization of Appell's Factorial Functions," Dr. E. J. Wilczynski, University of California.

The American Chemical Society also accepted the generous hospitality of Columbia University for their meeting. The chemists were welcomed to Columbia by President Low, and the meeting was held in Havemeyer Hall. They were also welcomed by Prof. Charles F. Chandler, the head of the Department of Chemistry, and former President of the Society. Papers on various industrial and scientific subjects were read, and the members were entertained at luncheon in the laboratory of Columbia University.

The meeting was held under the direction of Dr. Charles E. Munroe, President.

One of the interesting features of the session was a paper by A. C. Langmuir, the subject being "The Determination of Arsenic in Glycerine."

F. W. Clarke read the sixth annual report of the committee on atomic weights. "I have here," he began cheerfully, "forty pages, mostly figures"—a sigh of profound resignation from the chemists—"which I don't propose to read." This assurance caused the body of scientists to thaw with a celerity hitherto unapproached. The speaker said that fully two-thirds of the work on atomic weights of the year 1898 had been done in this country. When he had finished, Dr. McMurtrie moved that a committee of five be appointed to confer with committees which might be appointed by other chemical associations of the civilized world, and endeavor to agree on a uniform standard of atomic weights. The chair later appointed the committee.

The Society attended a lecture by Charles E. Tripler in the College of the City of New York, and some intensely interesting experiments with liquid air were shown.

The most novel one, conducted by Prof. R. Ogden Doremus with liquefied oxygen, furnished by Mr. Tripler, was placing the oxygen in a cup just below a huge magnet and witnessing its attraction by the magnet. As the shadow of the gas was cast by a calcium light on a white screen, it was seen to leap up to the magnet. "This," said Prof. Doremus, "is Faraday's experiment, proving oxygen to be magnetic."

In the evening the Society dined at the Waldorf-Astoria, Dr. William McMurtrie, chairman of the New York section, presiding. Among the various toasts was one responded to by President Seth Low, of Columbia University, on "Our Higher Education." He said in part: "The development of higher education means much for mankind, because institutions of higher teaching are giving opportunity to men to become acquainted with new laws of nature. That is my appeal for your support of the higher education."

A union meeting of all the scientific societies was held in the evening at the American Museum of Natural History, all of the various societies being the guests of the American Society of Naturalists. The members of the Society roamed at will through the great halls until they were summoned to the large lecture hall, where an address of welcome was delivered by Mr. Morris K. Jesup, president of the Museum. He predicted that the time would come when New York would take her proper place in the scientific world as a scientific and educational metropolis. Prof. Osborn also made an address, and a reception at Prof. Osborn's residence followed.

The meetings were continued on December 29, and a large number of interesting papers were presented, but space forbids even a list of titles. The annual meeting of the Society of Naturalists, with which the societies representing the special branches are affiliated, was held in Schermerhorn Hall, and President Low welcomed the members with an appropriate address. W. G. Farlow, of Harvard, was elected President; H. C. Bumpus, of Brown University, Vice President; T. H. Morgan, of Bryn Mawr, Secretary; and J. B. Smith, of New Brunswick, Treasurer. The general meeting took for the subject of joint discussion "The Advances in Methods of Teaching." The third annual meeting of the State Science Teachers' Association took place in the Teachers' College, in the morning, President Low welcoming them. In the evening a reception for the stranger teachers was given by the Trustees of the College. The annual dinner of the American Society of Naturalists was held at the Hotel Savoy, Prof. H. P. Bowditch, Dean of the Harvard Medical School, presiding, and he delivered the annual address as President.

The Export Trade for the Year 1898.

The exports from the United States for the calendar year 1898 will exceed those of any year. Only twice in the history of American commerce have the exports of a year passed the billion dollar line, but in 1898 they will reach the enormous sum of a billion and a quarter, the total for the first eleven months of 1898 being $1,117,681,199, and it is apparent that the December statement will bring the grand total of the year above $1,250,000,000. The figures of the Treasury Bureau of Statistics show that the November exports are not only the largest in November, but the largest in any month in the history of our commerce; while, as already indicated, those of the eleven months ending with November are larger than those of any full calendar year prior to 1898.

The import record of the year 1898 will be as remarkable as those relating to its exports; but, of course, by reason of a decrease, the total imports of the year are less than those of any calendar year since 1885. For the month of November they were $52,109,560, which was slightly less than those of November, 1897. For the eleven months ending with November they were but $579,844,153, while those of the corresponding months of 1897 were $691,089,266, which makes it apparent that the imports for the full calendar year of 1898 will not exceed $640,000,000—a sum less than the calendar year of 1897 and fully $100,000,000 less than that of the year 1897. With the largest exports in our history and the smallest imports for many years, the year 1898 will naturally show the largest balance of trade in our favor ever presented in any calendar year. The figures for the eleven months show an excess of exports over imports amounting to $537,837,046, and it is quite evident that the December figures will bring the total of excess of exports for the calendar year above the $600,000,000 line, making an average excess of exports for the year more than $50,000,000 a month, while the highest excess of exports in any preceding calendar year was $357,090,914 in 1897 and $324,263,685 in 1896.

A "Bacteria" Engine.

N. P. Melnikoff, the editor of the Russian journal Technologue, published at Odessa, informs us that he has made a little model of an engine which depends for its motive power upon the fermentation of bacteria. Although the engine in itself has no practical value, it nevertheless furnishes an interesting example of the power which can be derived from fermenting bodies. Mr. Melnikoff decomposes glucose into its constituents.

$$\underset{\text{Glucose}}{C_6H_{12}O_6} = \underset{\text{Alcohol}}{2C_2H_6O} + \underset{\text{Carbon dioxide}}{2CO_2}$$

One hundred and eighty parts of glucose will give ninety-two parts of alcohol and eighty-eight parts of carbon dioxide gas. In a copper vessel, glucose, an acid phosphate, acetic acid, gelatine, water (75 per cent), and yeast, are mixed together. After twenty-four hours, the gas within the vessel, at a temperature of 20° C., will have attained a pressure of four and one-half atmospheres. The inventor states that, if the vessel containing the yeast-bacteria be large, and the engine cylinder be correspondingly proportioned, enough power can be obtained to operate an engine uninterruptedly for twenty or thirty hours. The fermentation of different bacteria will give different results, the power produced depending upon the quantity of carbon dioxide or other gases generated by each species of bacteria. Mr. Melnikoff is at present engaged in experimenting with bacteria giving ethylene, hydrogen, and other gases.

Aconcagua Again Ascended.

Sir William Conway has been the third to ascend Aconcagua. He reached the summit on December 7, and was four days in making the ascent. The weather was perfect, and in this respect the ascension had a great advantage over Fitz Gerald's party of 1896-97. No particulars of Sir William Conway's trip are available as yet. He has now gone to Terra del Fuego, where he hopes to reach the summit of Mt. Sarmiento, the high peak on the south coast. A number of early attempts to conquer Aconcagua have failed, but Mr. Vines and the Swiss guide Zurbriggen succeeded in making the ascent. The leader of the Fitz Gerald expedition did not reach it. Aconcagua is entirely in Argentine, and is in plain view from the Pacific. When Mr. Vines was on the summit of Aconcagua, the thermometer registered thirty-five degrees below the zero point. He found at the highest point an almost square platform, extending about 225 feet on all sides, and sloping slightly to the north. To the south and southwest the sides were precipitous, and to the southeast there is an enormous precipice of nearly 10,000 feet, covered with great masses of snow and ice, forming a sight which was indescribable.

Correspondence.

Turret Versus Barbette.

To the Editor of the SCIENTIFIC AMERICAN:

I notice one peculiarity in your description of ships of the British navy, in your issue of Nov. 26. The heavy guns, or main battery, in almost all of them are not mounted in turrets, after the fashion in the United States navy. Why is this? Is it a fact that, when the turret is deranged, the gun is also deranged, and that we have had instances of this difficulty in our navy in time of peace and also during the late war? Why do the American authorities continue to use the turret, if it is liable to seriously affect the working qualities of the ships in question?

What is the object of the British authorities in using such light armor as you mention for the so-called "Canopus" class? It seems to us that ships of that class could more consistently be called armored cruisers than battleships. A. B. C.

Chattanooga, Tenn.

[The system of mounting "en barbette" was adopted in the British navy because of the superior "command" (height of guns above sea) thereby secured. Compare illustrations of the "Resolution" and the "Hood," in the issue referred to. The guns in the barbette ship are 27 feet above the sea and in the turret ship only 19 feet. The turret and the guns turn together and rest upon the same turntable; hence the blocking or displacement of the turret would probably disable the guns. These disadvantages, however, are offset by the complete protection afforded by the turret, not only to the delicate breech-mechanism, but to the gun crew, whose morale cannot but be favorably affected by the fact that they are shielded by a complete wall of 12 or 18 inches of armor. The English have compromised the matter by mounting a sloping gun shield, of a maximum thickness of 6 to 10 inches, upon the gun carriage, which rotates with the guns.

The reduction in thickness of the armor on later British ships (and, indeed, on all other ships) is due to the improved quality of the armor. The 6-inch side armor in the "Canopus" has behind it a sloping 3-inch deck, the two together being equal to 10½ inches of Krupp, or say 13 inches of Harvey armor. The "Canopus" is what the Italians call a cruiser-battleship. She has the speed and protection of the one with the armament of the other.—ED.]

The British Navy.

To the Editor of the SCIENTIFIC AMERICAN:

I have read with much interest the two articles in the issues of November 26 and December 10 upon our navy. As I believe the march of events will compel our navies to act in conjunction in the not very distant future, it is as well that intelligent discussion should be had, so that we may each profit from observing the good and bad points in the other. But in making your criticisms and comparisons, I venture to submit that you have fallen into the common error of critics of our navy, by failing to realize that it occupies a unique position among the navies of the world, and therefore cannot fairly be compared with them ton for ton. The navies of the United States, France, Germany, Italy, Russia, being on the same plane can fairly be thus compared; the duties that their ships would have to perform are more or less similar; they are, after all, only a part of the scheme of national defense; they are not the life blood of the nation. But with Great Britain and her navy it is different. It is not our first line of defense, it is our only line. If our shores bristled with fortifications and we kept a standing army of five million men, of what avail would they be if our navy was defeated and scattered? The victorious enemy would not have to land a man on our shores, would not have to come near us, to reduce us to abject submission, and that in very short order.

This being the case, our navy must act on the aggressive and keep on the aggressive. The enemy's shores must be made our frontier, their fleets must be sought out and defeated or driven into their harbors and kept there. To do this it was recognized that our ships must have sea-going and sea-keeping qualities in a greater degree than the corresponding ships of other nations, to enable them to maintain their positions outside an enemy's port in all kinds of weather and for a long time. So when we design a ship with an eye to matching a rival's ship, we make the armament about the same and then we add on two or three thousand tons to give us room for the extra supplies of coal, ammunition, and stores. Now if we were to pile on armament in proportion to the extra tonnage, we could only do so at a sacrifice of that which is a fundamental law in the designing of our, ships. Thus it comes about that if a war breaks out, the "Jéna," with her 12.052 tons and her four 12-inch and eight 6·4-inch guns, will be matched with the "Majestic," with her 14,900 tons and her four 12-inch and twelve 6-inch guns. And the "Gueydon," with her 9,517 tons and her two 7·6-inch and eight 6·4-inch guns, will be somewhat overmatched by our "Cressy," with her 12,000 tons and her two 9·2-inch and twelve 6-inch guns. This seems to me a fairer way to judge our navy, not ton by ton, but by the ships they would be pitted against in the event of hostilities. Again, it never seems to strike critics that there are two sides to every question. Is it not just possible that the other ships may be overgunned? We know that a Russian cruiser split her decks across while at gun practice on the Black Sea. We know that some of the guns in the French ships could not be fired because the blast of discharge would stun the crews of other guns, and I believe something similar happened on the "Brooklyn" recently.

Such guns are worse than useless. Besides, every ton added above a certain level reduces a ship's steadiness in a sea. This was strikingly illustrated when the Czar visited England. On leaving he was escorted to mid-channel by the British battleships at a 14-knot speed, riding easily and steadily. When taken over by the French battleships his yacht had to slow down to 9 knots, and the French ships were wallowing in the cross seas. What was the "Indiana" doing when her guns had to be lashed? She must have been rolling heavily, as big a mark as ever, but of no value as a gun platform. To drive the argument home, here are some figures:

"Alabama," 11,525 tons; four 13-inch, fourteen 6-inch, sixteen 6-pounders, four 1-pounders.
"Oregon," 10,288 tons; four 13-inch, eight 8-inch, four 6-inch, twenty 6-pounders, six 1-pounders.

The newer ship has 1,237 more tonnage and carries, if anything, a lighter armament. Either the "Oregon" is overgunned or the "Alabama" is undergunned. You warn us in your article to remedy this defect in our future ships. It looks as if you were remedying yours the other way.

In your article, speaking of the large guns of the "Royal Sovereign" class, you say, "the gun crews are entirely exposed." Mr. H. W. Wilson, in his "Ironclads in Action," Vol. 2, page 235, speaking on the same subject, says, "Her (the 'Royal Sovereign') guns are, of course, much exposed. On the other hand, the men working them are most adı irably protected." It is clear that one of you gentlemen is in error, and I am not accurately enough informed to say which, though I am inclined to think Mr. Wilson is in the right; for I think the gun crew work below the level of the barbette, the breech of the gun being depressed for loading, etc.

Touching speed, you say that the enemy's commerce destroyers of over 21 knots could only be open to attack by the "Powerful" and her sister, and further on you think the supply of coal of these two ships excessive. It must always be remembered that our speed tests are very severe, conducted as nearly as possible under service conditions, and that the ships are rated for speed at the mean of their natural draught. This is not always the case in other navies, the result being that our ships show a disposition to maintain their averages, while those of other navies fall off. Take, for instance, the commerce destroyer "Columbia." She was specially prepared for her trip across the Atlantic and was ordered to steam at full speed with natural draught until the last day, when she was to use forced draught. She did not average 19 knots. When the "Blenheim" was sent to Madeira to bring home the body of Prince Henry of Battenberg, she was in no way specially prepared, and without using forced draught she made the run to Portsmouth at an average of a fraction over 20·5 knots. I see that the "Argonaut," who has just completed her eight hours' natural draught contractors' steam trial, averaged 21·17 knots, although she is only supposed to be a 20·75 knot boat. In connection with the coal supply of the "Terrible," I should say her usefulness depended more upon her ability to maintain herself at sea in running down her quarry than in the number of our coaling stations. I note that on the 15th of September last the "Terrible," on her four hours' forced draught trials, reached the high average of 25·9 knots.

I am afraid I have been somewhat prolix, but our navy is very near to every Englishman, and I thought I might venture to point out that in some of your criticisms you had approached the subject from a mistaken standpoint. BRITON.

Philadelphia, Pa., December 20, 1898.

[Our correspondent has failed to see that we dwelt at considerable length upon the very facts which he accuses us of ignoring in an article which was intended to be commendatory. We stated in the second article on this navy (issue of December 10) that it was the policy of the British navy to produce vessels "with a moderate number of guns, thoroughly protected and well supplied with ammunition, rather than with an excessive number of guns poorly protected and carrying a limited supply of ammunition. The policy is well suited to the needs of Great Britain, but we think it has been pushed a little too far. If the "Powerful" could throw overboard 1,000 out of her 3,000 tons of coal, and replace it with four 8-inch and four 6-inch rapid-fire guns, she would be sure of any cruiser she could overtake, which is more than can be said of her at present. The reputed 25·9 knots speed of this ship is obviously an error.—ED.]

Miscellaneous Notes and Receipts.

Construction of a Grotto.—A box of suitable height and width forms the foundation. On the upper part, small pieces of a lath are nailed, inside, over the corners, so as to give the necessary arch. Next lay out the box with reed, in a suitable manner, allowing the protruding leaves to remain. The box with the reed is now studded with small nails. Next prepare in a vessel enough gypsum, stirred in water, as is thought necessary. This plaster pour into the box and shake the latter to and fro, so that the gypsum enters all the crevices, and especially covers the reed. When it is found that the plaster commences to "set," the box is set up, so that the gypsum can incline downward in the nature of stalactite (filtering stone), and is allowed to harden. When the gypsum has become hard, paint it with suitable size paint, coat a spot here and there with glue, and throw on crushed glass, paste a little moss in some corners, and the Loretto group is done.

If the grotto is not, as is usually done, placed in a niche in the wall, but is to stand free, the outside walls of the box have to be treated in the same manner as the interior.—Der Dekorationsmaler.

Decorating Crude Iron Ware.—This patented process has the purpose of covering crude iron ware with a hard, non-cracking varnish, which is impervious to fire and can be decorated in a new and unique manner by simply coating with a gold solution. The iron varnishes heretofore employed showed the drawback that the colored varnish was not fire-resisting, but turned black in the heat, so that it has been impossible before to obtain a varnish-covering other than black for iron ware subsequently heated in fire.

To give iron articles a fire-resisting, brown varnish coating, proceed as follows: Mix pulverized potassium sulphide, such as is used for galvanic baths, with pulverized copal, pulverized crystalline potassium cyanide, and pulverized sodium bicarbonate. After these substances have been intimately intermixed, a simple coloring body, e. g., Vandyke brown (Cassel brown) is added and mix the whole thoroughly again.

The quantity of the coloring matter is dependent upon the shade of the color which is desired. After that, the compound is so far saturated with absolute alcohol as to form a paste, which is coarsely filtered to separate the undissolved particles. The moist paste, which constitutes a colored mass, is applied on the iron. The latter is then placed in the furnace and heated to 200° C., but may be heated to 300° without losing its color.

After the objects have been taken from the furnace and cooled off, a brush is passed over them, which has been dipped in a gold solution. A painting of the surface or certain parts of it is not aimed at, the object being to have the gold solution appear subsequently only in some places, which gives the article a novel and unique appearance.

Of the constituents forming the varnish, the potassium sulphide effects the firm combination of the varnish with the iron, the copal completes the gloss, the potassium cyanide prevents the oxidation of the iron in the heat and hardens the varnish so that, after it is burnt in, it cannot be removed from the iron, even by the use of steel brushes. After the gilding has been applied in the indicated manner, the object is once more placed in the oven and baked again, so as to permanently unite the varnish and the gilding. The mission of the sodium bicarbonate is to render the varnish easy of working, it being very difficult to apply it on the article without this mixture. If any other than a brown shade is desired, add to the varnish, before baking, some other fire-resisting color or one which changes as desired in the heat, and proceed otherwise as pointed out above.—L. Edgar Andés, in Neueste Erfindungen und Erfahrungen.

Horseless Vehicles for Europe.

It was announced on December 28 that the Fisher Equipment Company, of Chicago, had contracted to furnish a large number of electric vehicles for exportation to Europe during the next ten years. Contracts have been closed with the Holyoke Works, Holyoke, Mass.; Stanley Automatic Carriage Company, Newton, Mass., and the Overman Wheel Company, Chicopee Falls, Mass., to furnish a thousand vehicles a year for ten years. The Massachusetts factories are to turn out steam, gasoline, and petroleum motors, while the Chicago concern will manufacture electric carriages and motor cycles. It is said that 1,500 vehicles are to be made per year by the combined companies, and it is said that the aggregate price to be paid will not be far from $15,000,000. The first vehicles will be shipped in January, and the Paris office will be opened on the Champs Elysées, and branches will be established in London, Berlin, Vienna, and Brussels. The Count de Jotemps, who closed the contract, said: "The American patents on horseless vehicles are the only ones of practical value on the market. In Europe we have nothing that can compare with the American motor-vehicles, either in lightness, easy running qualities, rigidity, or stability. We are satisfied that America will furnish the horseless carriage of the future, and it is our idea to control the supply."

THE NEW EAST RIVER BRIDGE.

Work upon the new East River Bridge is so far advanced that the completion of the piers for the steel towers is within measurable distance and the masonry of the anchorages inshore is assuming definite shape. On the New York side the piers are completed and capped ready for the steelwork, and the anchorage is well under way. On the Brooklyn side one of the piers is completed (this pier is shown in the illustration), while the foundations of the other pier have been carried down to bed rock and the masonry is being built up to its finished level. The first few courses of masonry in the anchorage have been laid and the anchorage plates and girder platforms have been built in place.

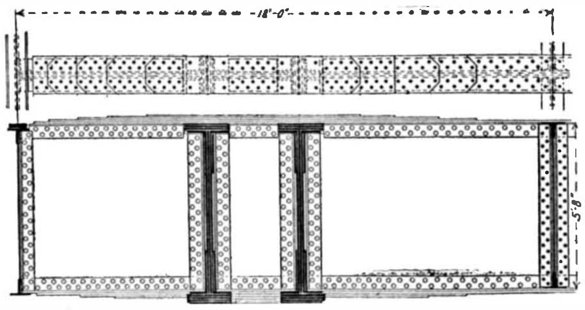
The new bridge will be the largest, the strongest, and the most handsome of the large suspension bridges of the world. Its entire length between terminals will be 7,200 feet, the length of the main span, center to center of towers, will be 1,600 feet, and the extreme width of the floor, from railing to railing of the outside sidewalks, will be 118 feet. The next largest suspension bridge is the famous structure a mile and a half down the East River, which is 1,595½ feet between towers and 3,455 feet long between the anchorages. It is in the great width of the floor and number of railway tracks carried that the new bridge exceeds the older structure. The present bridge is only 80 feet wide as against 118 feet, and carries only four tracks as against six. The new bridge, moreover, having the advantage of later improvements in the materials and methods of bridge building, will be a much stiffer and, relatively to the loads it will carry, a much stronger structure.

The foundations of the towers are timber and concrete caissons sunk in every case to bedrock. Above these are solid masonry piers, two for each tower, which are carried up to 23 feet above high water. Upon each pier, one at each corner, will be laid four massive pedestal blocks of dressed granite to form the footings for the four legs of the towers. The towers consist of four corner posts or legs strongly braced together, the two groups of four on each pier being connected by massive transverse lattice trusses and diagonal ties. The tops of the towers will be 335 feet above the river and 442 feet above the lowest foundation. The center span will be carried upon four 18-inch steel wire cables which will extend inshore 590 feet, where they will be anchored to masonry anchorages. The inshore portion of the cables will not, as in the Brooklyn Bridge, carry the shore spans, but the latter will be supported by the tower, the anchorages, and an intermediate pier. The arrangement is shown very clearly in our front page engraving.

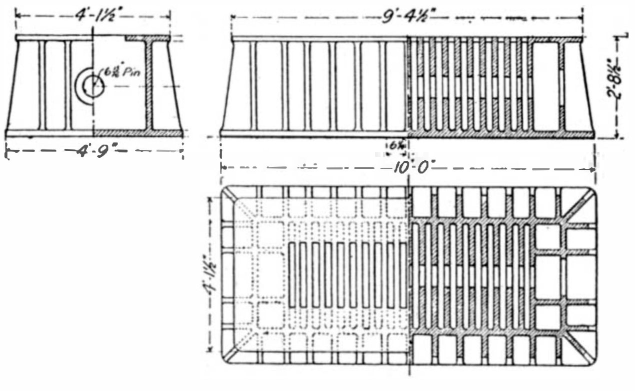
A further point of difference from the Brooklyn Bridge will be the method of stiffening the floor against deformation. In the Brooklyn Bridge this is accomplished by six shallow trusses assisted by a series of stiffening cables running from the panel points of the trusses to the tops of the towers—an unsatisfactory and unscientific arrangement, as the recent buckling of the trusses has proved. In the new bridge stiffness is imparted by two continuous lattice trusses 40 feet in depth and of great solidity. At each panel point of the trusses a deep plate-girder floorbeam, reaching clear across the floor, will be riveted to the trusses. The stiffening trusses will be 67 feet apart, and to support the floorbeams at the center, vertical ties will be carried up from two points on the floorbeams to connect with light transverse trusses which will connect the stiffening trusses overhead.

The new bridge will not have any terminal stations, the purpose being to provide a broad, continuous thoroughfare over which trains, vehicles, and pedestrians may pass without any interruption, the bridge thus forming a part of the street system of Greater New York.

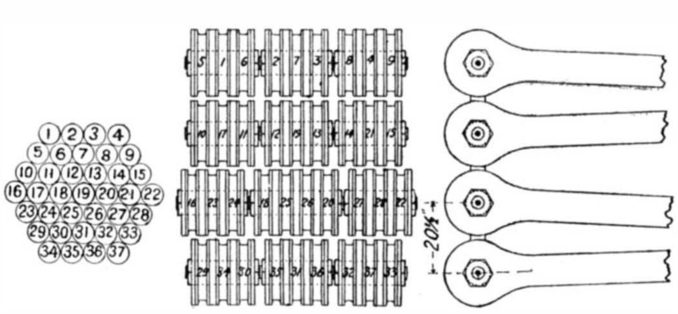
The construction of the piers of the Brooklyn towers is similar to that of the New York piers, which was described in an illustrated article in our issue of August 7, 1897. The only difference is in the depth of the foundations, which in the case of the second of the two piers were carried down to 107 feet below high water. The caissons are, consequently, deeper than those on the New York side, and it was not necessary to introduce the heavy steel stiffening girders which are a feature in the first-named caissons. The last caisson to be sunk passed through 50 feet of water, 20 feet of sand, gravel, and bowlders, 30 feet of hard clay and hardpan, and 12 feet of rock. The rock excavation was rendered necessary by the steep slope of the rock. The rock was stepped out and the lower side of the slope was concreted up to meet the lower edge of the caisson, the whole of the working chamber being ultimately filled with concrete and grouted up with liquid cement.



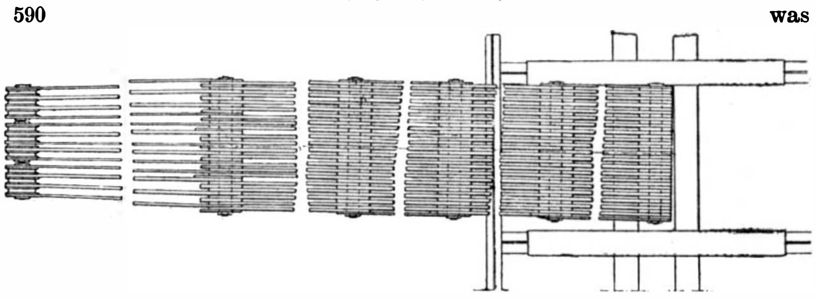
6.—DETAIL OF ANCHORAGE GIRDERS FOR INSIDE CABLES.



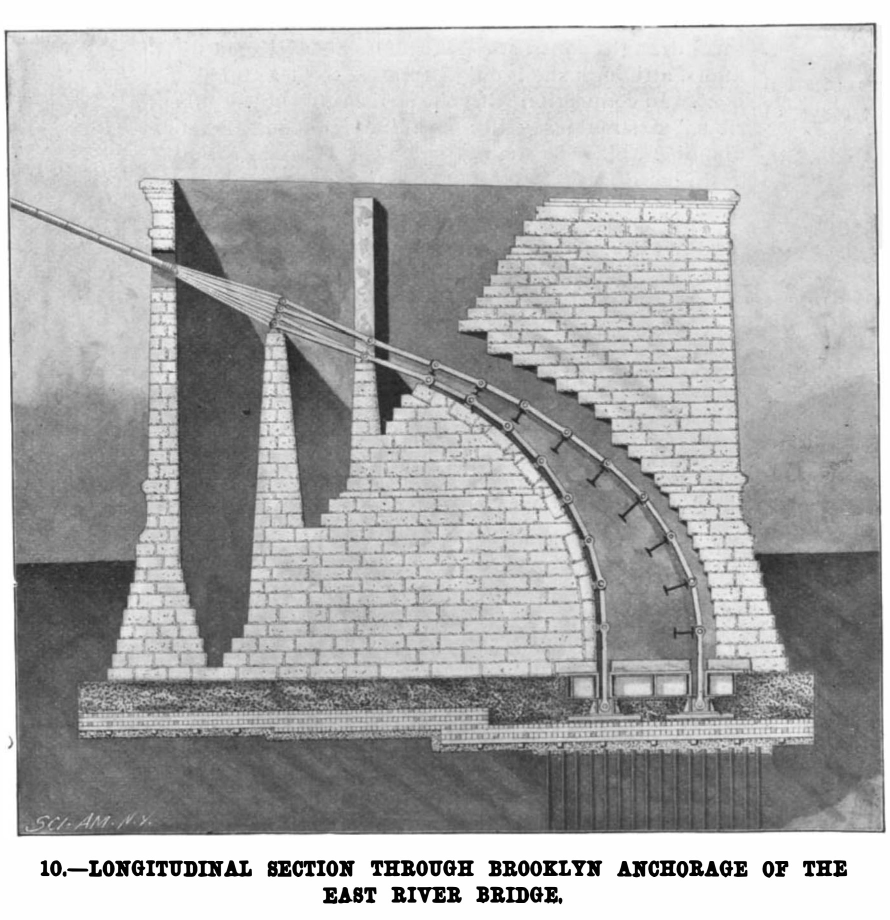
7.—ANCHORAGE PLATE—WEIGHT, 11¾ TONS.



8.—METHOD OF ATTACHING CABLE STRANDS TO ANCHOR CHAINS.



9.—PLAN SHOWING ARRANGEMENT OF LOWER ANCHOR CHAIN BARS FOR ALL CABLES.



10.—LONGITUDINAL SECTION THROUGH BROOKLYN ANCHORAGE OF THE EAST RIVER BRIDGE.

The sinking of this caisson, which was carried out under Mr. James Tabor, was a very rapid and successful piece of work, especially in view of the great depth to which the caisson was carried. The sinking and concreting was done in three months and six days of actual work. The caisson measures 63 feet by 79 feet and contains 74,700 cubic feet of timber and 98 tons of iron, chiefly in the form of drift bolts. Its weight, without the concrete, is 1,965 tons. Above the roof of the working chamber are 6,000 yards of concrete. Above the caisson was a cofferdam 50 feet deep, which contained 29,000 cubic feet of timber and 32 tons of iron. The sinking was accomplished by a gang of men, who worked in shifts of eight hours each, down to a depth of 55 feet. Below this the shifts were shortened, being six hours long down to 70 feet, four hours down to 80 feet, two hours down to 90 feet, one and a half hours down to 107 feet. The shifts were latterly divided into two, each of which was only forty-five minutes long. The pay of the men who carry on this arduous work is increased in proportion to the depth, varying from $2.50 for the eight-hour shift up to $3.75 for the short shifts at the lowest level. One of our illustrations shows an air-lock hoist of the kind used for taking out the excavated material. Another hoist for the men carried a cage 5½ feet in diameter, which has brought up as many as eighteen men at a time. The air pressure at the 107-foot level was 46 pounds per square inch, yet there was very little sickness, and only one case was serious.

The piers are built of limestone masonry up to the low water level, above which they consist of granite facing with a limestone backing. The piers are finished with two heavy coping courses of simple but handsome design, and one pedestal course, consisting of four selected granite blocks measuring 8 feet by 8 feet by 3 feet in thickness.

The anchorages for resisting the pull of the cables will be extremely massive and imposing structures. They will measure 182 feet in width, 158 feet in depth, and 120 feet from the foundation to the coping. Forty feet of the mass will be below the street level, above which it will rise some 80 feet. The excavation at the Brooklyn anchorage was first concreted to a depth of from 18 inches to 3 feet (see view, Fig. 10). Above this was built a platform of four layers of timbers strongly bolted together, while over the platform was laid a great mass of concrete from 6 to 10 feet in thickness, reaching up to high water level. Above this the masonry commences. It is laid in 3-foot courses, and the blocks, as can be seen from the engravings, are several tons in weight. Altogether there will be in one anchorage 44,597 cubic yards of masonry, and the total weight, including concrete platforms, etc., will be 125,000 tons.

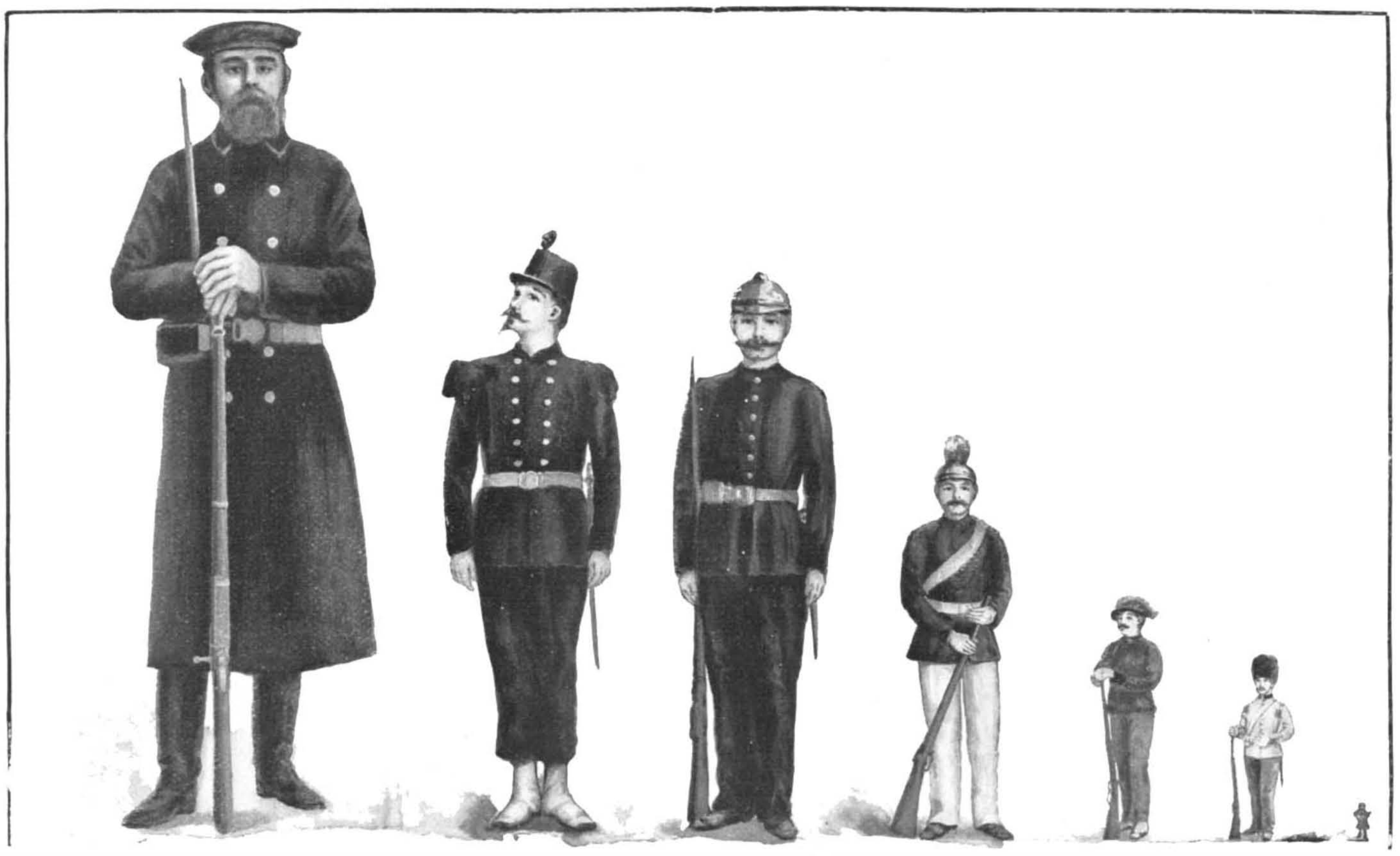
The total pull of the four cables will be 20,250 tons. The anchorage could only move by being rotated about its toe, or by sliding bodily forward. To resist rotation the masonry is massed at the rear (see illustration, Fig. 10), the forward half being of hollow construction. Sliding is resisted by the mass of earth 40 feet deep at the toe and by the frictional resistance between the great mass and the earth upon which it rests. The latter is increased by stepping the bottom of the foundation.

The pull of the cables is transmitted to the foundation by eight sets of anchor chains, two to each cable. The strands are separated as they enter the masonry and passed around large spools carried at the ends of the anchor chains. The distribution of the strands is shown in the accompanying cut. The chains are made up of steel eye bars 2 inches thick by 9 inches deep. They are carried through curved tunnels in the masonry down to massive anchorage platforms located at the base of the masonry, where it rests on the concrete. The platform are made of deep and very heavy intersecting girders of steel. There is a single platform for each outside cable and a larger double platform for the two inside cables. The outside platforms are 24 feet by 36 feet and weigh 100 tons each, and the inside platform is 36 by 50 feet and weighs 225 tons. The chains pass down through the platforms and are pinned into massive cast anchor plates of the form shown in Fig. 7. These are strongly ribbed to enable them to stand the great pressure to which they are subject. The object of the platforms is to distribute the upward pull of the chains throughout the mass of the masonry. To further distribute the pull of the chains, they are divided into two sets, one above

the other. At each link the chains rest upon the masonry, either directly by means of pedestals or by means of short transverse girders, which transmit the pressure to the side walls of the tunnels in which the chains are laid.

Our illustration, Fig. 2, shows the four anchor plates in the central pit before the anchorage girder platform has been built over them. In Fig. 3 is shown a side platform completed, with deck beams in place ready for the masonry.

We are indebted to the chief engineer, Mr. L. L. Buck, for the plans from which the present article is prepared.



RELATIVE SIZES OF THE WORLD'S STANDING ARMIES GRAPHICALLY REPRESENTED.

THE ARMED FORCES OF THE WORLD.

The plan of the Czar to disarm the standing-armies of Europe, admirable and humane though it be, is, perhaps, too indefinite in character to enable us to form any judgment as to its chances of success, or as to its ultimate results, should it prove successful. Universal peace may be a chimera, a mere dream, but one thing at least is certain—the imperial autocrat's manifesto to the Powers calling for a general convocation for the disarmament of European troops has concentrated the attention of the world on the enormous masses of men supported by the European governments. Time and time again it has been said that all Europe is but a vast camp, that every man is compelled to spend part of his life in a barracks. The evil, instead of decreasing, has become more menacing with each succeeding year. For in the endeavor of a nation to bring its armies to as high a state of efficiency as that of some rival power, it is compelled to augment the number of its troops each year by a constantly increasing ratio. In the struggle for martial supremacy some nations have naturally surpassed others. It would be a most difficult task to ascertain exactly what army is the strongest; for the efficiency of a force depends not upon numerical strength alone, but upon the discipline of the men constituting that force, upon the manner in which these men are armed, upon the term of service, and upon many other factors. It is, therefore, evident that no statistics, however accurate, can exactly indicate how much greater the efficiency of one army is when compared with another. So far as mere numbers are concerned, it would not be difficult to ascertain which army is the largest, and this we have endeavored to do in the present article.

According to the best information at hand, the peace-armies maintained by the principal nations exclusive of native colonial troops may be tabulated thus:

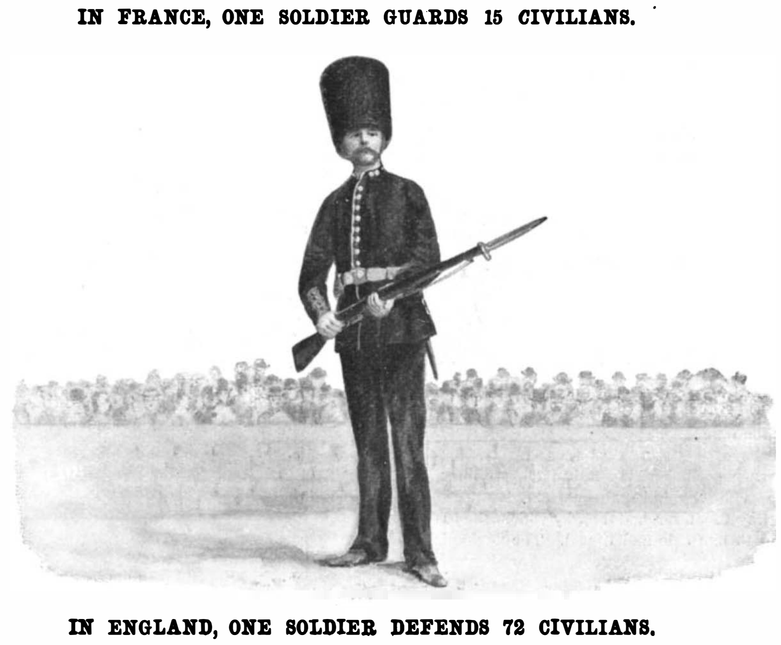
TABLE I.—ARMIES ON A PEACE-FOOTING.

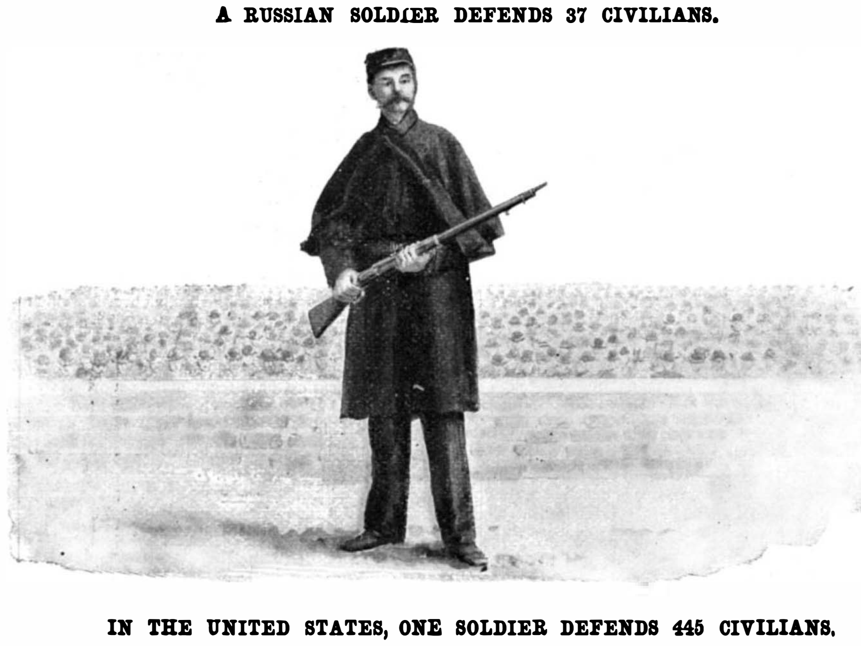
Russia	860,000	Italy	231,355
France	615,413	Great Britain	163,569
German Empire	585,440	United States	25,000
Austria-Hungary	385,697		


IN GERMANY, 17 CIVILIANS ARE DEFENDED BY A SINGLE SOLDIER.


IN FRANCE, ONE SOLDIER GUARDS 15 CIVILIANS.


A RUSSIAN SOLDIER DEFENDS 37 CIVILIANS.


IN ENGLAND, ONE SOLDIER DEFENDS 72 CIVILIANS.


IN THE UNITED STATES, ONE SOLDIER DEFENDS 445 CIVILIANS.

From this table it is evident that Russia's army in time of peace exceeds that of any other nation. France and Germany are about equal in numerical strength, France, however, having the larger force. Our own army of 25,000 men appears but a handful when compared with the hundreds of thousands of men maintained by the European Powers.

Although Congress enacted last spring that the standing-army of the United States shall, in cases of emergency, be increased to 62,597 men, we have nevertheless retained the legal peace footing of 25,000 men, as the strength of our army under normal conditions. Our newly acquired territories will probably require a force considerably in excess of the 62,597 men already mentioned.

In endeavoring to estimate the number of men in the various armies when on a war-footing, it is somewhat difficult to obtain accurate figures. In time of war the entire male population of a European country may be drafted into the army. Of the war-strength of Germany no official statistics can be obtained; but with her present organization, Germany, in case of invasion, can muster an army of 3,000,000 men. Austria-Hungary has a "Landsturm" of 4,000,000 men, in which all citizens not members of the army, navy, or Ersatz-Reserve are obliged to serve from their nineteenth to their forty-third year. The following table gives the war-footing of the various countries :

TABLE II.—ARMIES ON A WAR-FOOTING.

Russia	3,503,000
German Empire	3,000,000
France	2,500,000
Austria-Hungary	1,827,178
Italy	1,268.308
Great Britain	526.220
United States	140,627

Our own army, even on a war-footing, again seems small when compared with the million men that constitute an Old World force. In arriving at the war-strength for the United States in the foregoing table, we have added together the number of men in our standing-army and in our drilled militia, these being the only effective forces of trained men at our disposal in cases of emergency, and therefore corresponding more nearly in character with the European war-armies than a force composed largely of volunteers.

The army of one country, in the relation which it bears to the population of that country, may be comparatively larger than the army of another nation. The proportion of inhabitants to the number of soldiers gives one a better conception of the enormous size of a European force than a mere statement of its numerical strength. In Table IV. these proportions of population to the various armies are given :

TABLE III.—POPULATION.

	Population.	Census.
Russia	129,166,561	1897
United States	62,622,250	1890
German Empire	52,279,915	1895
Austria-Hungary	41,231,342	1890
France	38,517,975	1896
Great Britain	38,104,975	1891
Italy	31,114,589	Estimated.

TABLE IV.—NUMBER OF INHABITANTS TO EACH SOLDIER.

	Peace.	War.
France	62·589	15 407
German Empire	89·300	17·427
Austria-Hungary	114·920	22·023
Italy	135·249	24·671
Russia	150·194	36·873
Great Britain	232·959	72·413
United States	2,488·890	445·307

What enormous armies France and Germany maintain, is shown by the fact that France requires one soldier to defend every fifteen of her citizens ; and the Kaiser one soldier to protect seventeen of his subjects. The marked disparity between the conditions in Europe and in the United States will be appreciated, by comparing the figures in the foregoing table.

Of the relation of the armies to population, Table V. will give still further information :

TABLE V.—NUMBER OF SOLDIERS TO EVERY THOUSAND INHABITANTS.

	Peace.	War.
France	15·822	64·907
German Empire	11·200	57·383
Austria-Hungary	8·700	44·315
Italy	7·394	40·533
Russia	6·658	27·120
Great Britain	4·293	13·810
United States	0·399	2·246

A nation with a large expanse of territory requires a larger army than a smaller country. A vast country like Russia would, no doubt, be more difficult to defend against invasion than a country of comparatively small dimensions. What relation the armies bear to the territories which they defend is shown by the following tables :

TABLE VI.—AREA IN SQUARE MILES.

Russia	8,666,394
United States	2,970,000
Austria-Hungary	240,942
German Empire	208,830
France	204,092
Great Britain	120,979
Italy	110,646

TABLE VII.—NUMBER OF SOLDIERS PER 10 SQUARE MILES—PEACE.

France	30·154
German Empire	28·034
Italy	20·913
Austria-Hungary	14·846
Great Britain	13 521
Russia	0·993
United States	0·084

TABLE VIII.—NUMBER OF SOLDIERS PER 10 SQUARE MILES—WAR.

German Empire	143·657
France	122·494
Italy	114·627
Austria-Hungary	75·531
Great Britain	43·497
Russia	4·042
United States	0·473

On a peace-footing France provides a larger number of men for every ten square miles of territory than any other nation. On a war-footing, however, Germany, with her larger army, is enabled to assume the lead. Russia, by reason of her enormous possessions, can provide barely one man on a peace-footing and four men on a war-footing for every ten square miles. The smallness of Italy, coupled with her large army, has enabled her to assume the third place in both tables. Great Britain in all these lists occupies a low position ; but it must not be forgotten that her large navy compensates for the smallness of her army. In the tables, Russia's Siberian army has been included, because the European and Asiatic possessions of the Czar constitute one, unbroken realm.

The expense incurred in maintaining these large armies is enormous. It enervates a nation, drains its resources, imposes upon the people taxes which cannot but breed discontent, and paralyzes the productive forces and the elements of social well-being. What the maintenance of a standing army means to the youth of a country is well shown by a passage in a recently revived speech made by Lord Randolph Churchill. He said in part :

"Out of the life of every German, every Frenchman, every Italian, every Austrian, and every Russian, the respective governments of those countries took three years for compulsory military service. If they estimated these years at eight hours a day for six days a week, they would find that it came to this—that out of the life of Europeans in those nations . . . no less than 7,500 hours were taken for compulsory military service, during which time the individual so deprived was, for purposes of contribution to the well-being of the community, as a whole, by his labor, as idle, as useless, as unprofitable, as if he had never been born."

The Current Supplement.

The current SUPPLEMENT, No. 1201, has many interesting articles. "A Problem in Shipbuilding" describes the lengthening of the "Spree." "The Cox Type-Setting Machine" deals with an ingenious type-setting and justifying machine. "The Mining and Minting of Gold and Silver" is a full paper. "A Short History of Scientific Instruction" is by Sir Norman Lockyer. There are a number of other interesting articles and the usual short notes.

Contents.

(Illustrated articles are marked with an asterisk.)

RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

CULTIVATOR AND DRAFT - EQUALIZER.—WILLIAM F. NATSCHKE, Cissnapark, Ill. With this draft-gear and cultivator, it is possible to employ four horses abreast, means being provided to direct the course of the cultivator in accordance with the direction given to the horses. A vertical frame has upright side bars connected at their upper ends by a top bar. A horizontal frame is provided with ways and slides thereon below the top bar. The horizontal frame can be adjusted in position by means of a lever and detent-mechanism.

COMBINED HAY RAKE AND LOADER.—PETER McA. LEONARD, Lac du Flambeau, Wis. This invention is an improvement in that class of hay-rakers and loaders in which a rake and endless traveling carrier are mount.d on an inclined frame supported by transporting-wheels. The machine is connected with the rear end of a wagon, and when drawn across the field the rake-teeth will gather the hay and pass it to the endless carrier-belt. After the hay has been dumped into the wagon, rearwardly-projecting arms or presser-bars act to prevent the hay's being blown away.

Electrical Contrivances.

COIN-FREED APPARATUS FOR GENERATING X-RAYS.—MAURICE VIDAL, Paris, France. This apparatus comprises a mechanical, automatic system connected with a fluoroscopic chamber provided with an automatic shutter and with a Crookes tube automatically illuminated. A coin dropped into the apparatus causes the dark, fluoroscope chamber and the Crookes tube to be simultaneously operated. The apparatus contains an accumulator for supplying the current to a Ruhmkorff coil, the poles of which are in communication with the vacuum or Crookes tube. The circuit of the accumulator is closed by an automatic mechanism operated by a coin.

SYSTEM OF ELECTRIC TRACTION.—MICHEL-ANGELO CATTORI, Rome, Italy. The traction system devised by this inventor permits the continuance on the same track of whatever system may have previously been employed. The railway is provided with two parallel sectional conductors arranged in two circuits. In each circuit an independent generator is included. Terminal switches enable one pole of each generator to be connected with the corresponding terminal of either conductor of the same circuit. By means of junction-switches, the other pole of each generator may be connected with the other end of either conductor of the same circuit

AUTOMATIC MAGNETIC CIRCUIT-BREAKER.—CHARLES M. CLARK, New York city. The purpose of this invention is to provide a circuit-breaker which can be set to break a circuit automatically in case of an overload, underload, or a combination of both, on single, two wire, or multiple circuits. Within the casing of the apparatus, a shaft consisting of two sections is mounted. A pawl is carried by one of the sections, and is adapted for locking connection with the other section. A disk is mounted on one of the shaft-sections, and is rotated by a spring. A contact-block carried by the disk is engaged by brushes in the electric circuit. A solenoid is placed in the circuit, and contains a core which operates to release the disk upon an overload, and to move the pawl out of its locking position. The block's being moved out of engagement with the brushes, by the action of the disk, will cause the circuit to be broken.

Bicycle Appliances.

SUPPORT.—WILLIAM F. WILLIAMS, London, England. By means of this improved device, a bicycle may be held in an upright position when traveling very slowly or when stopped altogether, so as to avoid the necessity of the rider's dismounting when stopped. The support, when brought down upon the ground, projects laterally at each side of the machine in position to act as a broad base, and to afford the desired stability. When raised, the support assumes a fore-and-aft position, the construction and operation of the support being such that the vertical and turning motions are independent, the latter motion being always performed when the support is out of contact with the ground.

Engineering Improvements.

GOVERNOR.—WILLIAM E. BROWN, Aral, Mich. To provide a sensitive device for controlling the slide-valve of an engine, this inventor has devised a governor which is provided with a casing secured on a shaft. A slide is fitted to slide in the casing and is pressed by a spring, the tension of which may be regulated. Weighted arms, fulcrumed in the casing, have segmental gear-wheels in mesh with racks on the slide. When the weighted arms swing outwardly by centrifugal force, an eccentric is operated by the arm to swing across the shaft and to operate the valve-gear accordingly.

Mechanical Devices.

VENEER-PRESS.—AXEL K. HATTEBERG, Mattoon, Wis. This invention seeks to provide a veneer-press arranged to press the veneers quickly, to insure good work, and to permit the handling of a large amount of work in a comparatively short time. The invention consists principally of a bed, a platen over the bed; a pressing device, adapted to be temporarily connected with the platen to press the veneers held on the bed, and means for locking the platen to the bed after pressing, to permit the removal of the pressing device, and to keep the veneers locked between the bed and platen until the glue is set.

DIAMOND - POLISHING MACHINE. — AUGUST WAUTERS, New York city. The inventor of this machine has endeavored to provide a means whereby the dop of his apparatus can be adjusted according to the desired number of facets to be formed on the diamond, and to insure a proper polishing relative to the desired inclination to be given to the facets and relative to the grain of the diamond. The invention consists essentially of a dop provided with a ball-and-socket joint; one member carries the diamond and the other is adjustably held in the supporting arm.

DITCHING-MACHINE. — WILLIAM WILGUS, Lafayette, Ind. In this ditching-machine, a scoop of semi-circular shape is employed and operated to enter the ground at one point, to pass through the ground, and to find exit at the opposite point, means being provided for forcing the scoop into and through the ground. The scoop is provided with a semicircular cover, both cover and scoop being pivoted upon the same shaft, so that when the cover is over the scoop, a cylindrical receptacle is formed for the dirt removed from the ground. The cover and scoop may be locked together when the scoop has received its load. The cylinder, comprising the scoop and cover, may be released from its support, and rolled from the opening in the ground to any point where the contents of the cylinder are to be discharged. In this manner a ditch of moderate depth may be made section by section, each time the scoop-section of the cylinder has been made to enter the ground.

Railway Contrivances.

LOCOMOTIVE COALING DEVICE.—WILLIAM M. PRICE, Ellsworth, Iowa. The purpose of this invention is to enable a locomotive to be coaled while under way, and thus save the time otherwise lost. This result is obtained by means of an apparatus, comprising a discharging-bin suspended on inwardly-inclined links, means for supporting the links, an operating lever, and a link connecting the lever and bin, by which the bin may be swung to one side and tipped. The device is mounted upon the tender of a locomotive, or upon a car. The locomotive upon which the apparatus is mounted, or to which it is attached, is to run upon a track parallel with the track carrying the locomotive to be coaled, and, regulating its speed to that of its neighbor, discharges its coal into the tender of the locomotive to be coaled.

CAR-COUPLING.—SETH BEDFORD, Charleston, Mo. This car-coupler is so constructed that the jaws may be automatically set in position to receive each other as the cars come together; that the jaws may be uncoupled by means of air-pressure; that air-pressure may be utilized to control the passage of air to the uncoupling devices under the control of the engineer, in order to enable him to uncouple a train of cars at any point; and that the couplings for the air pipes may be automatically united when pressed together by the meeting bumpers. Varying pressure is employed to effect the uncoupling at different points, such varying pressure being supplied to the pressure-pipe by means of the pressure-devices now commonly employed on locomotives.

Miscellaneous Inventions.

HEATING-DRUM.—HERBERT E. HARRINGTON, Walden, Vt. A drum has been devised by this inventor which conducts the heated currents by centrifugal force to the outer surface of the drum, causing the hot air and products of combustion to be utilized to the utmost. The drum is self cleansing and is designed to arrest sparks, it being well-nigh impossible for a burning particle to pass through. When set up, the drum may be turned out of the way.

MEANS FOR RACKING BEER.—EMIL KERSTEN, Richmond, Va. During one stage of the manufacture of beer the liquid is cleared in large casks partly filled with chips and shavings. After having been cleared the beer is filled into kegs, during which process a filter must be used to remove the sediment which has been shaken up during the filling. To avoid this the inventor of this new method draws the beer through an outlet vessel contained in the bottom of a cask having two inflows at different levels, so that the fine and clear portion of the beer above the sediment level is caused to flow through the outlet vessel; the remaining portion is subsequently withdrawn from the cask through the outer vessel by the inflow below the sediment level. By this arrangement the sediment is not disturbed, and the last portion of the beer contains impurities too small in amount to clog the filter.

COMBINATION ARTICLE FOR HOUSEHOLD USE.—CHARLIE E. KUHN, Mont Alto, Pa. An improvement in combination articles for household use has been herewith provided, which improvement has for a base a frame provided with corner posts secured together by cross bars. The end frames are joined by suitable braces, so that the frames may be folded when desired and may be provided with means by which various

attachments can be secured thereto, so as to adapt the device to various uses. To this framework as a base are secured attachments which adapt the device for use as a table, a flower-stand, and a clothes-rack.

BUCKLE.—JOHN C. ROSENKRANZ, New York city. To provide a buckle especially adapted for use upon trousers, waistcoats, and garments generally, and so to construct the buckle that it will be simple, capable of being conveniently manipulated, and of firmly gripping the fabric, are the purposes of this invention. The buckle consists of a frame having a toothed surface, and a spring tongue pivoted to the frame to swing parallel to the plane thereof, and with a tension at right angles to the plane of the frame, the tongue having a tooth at its free end adapted to enter the spaces between the teeth on the frame.

CARTRIDGE-BELT.—LOUIS SANDERS, New York city. In this belt two or more rows of cartridges may be carried. The cartridges in the several rows may be placed one in front of the other, each pocket being independent of the other. A separating device between transversely alining pockets is provided, which may be made of metal or similar hard material. In connection with the separating device, another device is employed, which is designed effectually to prevent cartridges from leaving the pockets, even should the diameter of the pockets become accidentally enlarged beyond the dimensions required to hold the cartridge in place.

PASTRY-BOARD.—WILLIAM L. STANLEY and PRESSLY C. PATTERSON, Cambridge, Ohio. This pastry-board is designed to be placed upon the kitchen or pantry table. The board is principally characterized by several layers of sheet metal forming the body of the board, and producing a durable and efficient structure.

NON-REFILLABLE BOTTLE.—HENRY WEIL, New York city. The neck of the bottle is contracted to form a seat for a ball-valve. Within the neck a tube is inserted provided with a spring-pressed flap valve. The ball and flap, acting in conjunction, are designed to prevent the refilling of the bottle.

WAGON-LOADING DEVICE.—LEONARD C. WOOD, Alden, Ohio. By means of this improved device, a wagon may be quickly loaded by means of scrapers and a team of horses. The device comprises an inclined plane having a hinged extension adapted to extend over the end of a wagon-box bottom, and an inclined guide adapted to engage the double-trees or draft-bar, to be carried up above the sides of the wagon.

TOY-BOAT.—JOSIAH T. CRAWLEY, Honolulu, Hawaii. The hull of this toy-boat is partly filled with water, which may be discharged through a minute pipe leading from the bottom of the hull. A support is arranged within the hull above the liquid, and upon it is placed sodium carbonate, or sodium bisulfate, mixed with an acid. The resulting gas will press against the surface of the water, and force it out of the discharge-pipe to propel the boat.

EGG-CARTON.—ROBERT J. BARKLEY, Chanute, Kans. This inventor provides a folding carton which has cells to the number of twelve. The carton is designed to contain a dozen eggs, and to obviate the necessity of counting and of the danger of breaking the eggs by frequent handling. The cartons are of such form as to be readily used in packing eggs into the wooden cases ordinarily employed in the egg-trade.

COMBINED HOLDBACK AND WHIFFLETREE.—WILLIAM B. FROST, North Lansing, Mich. The novelty of the present invention resides in the use of an arched singletree, which is pivoted between its ends, and which has its extremities carried forward and united with the ends of the breeching-piece, arched to receive back pressure when the horse is backed or is holding back. The pivot of the combined device permits the proper application of the back pressure for the purpose desired. The improvement can be used on light-draft vehicles or on heavy wagons.

CONTINUOUS BRICK-KILN.—EDWIN T. HARRIS, Ridgway, Pa. This invention is in the nature of a continuous brick-kiln formed with a series of separate kilns connected by suitable underground trunk-flues arranged so that a part of the kilns may be burning while the rest are being filled or relieved of their burnt bricks. The heat of a burnt-out kiln may be used to "water-steam" or dry out the bricks in the next kiln. The invention also seeks to control the furnace-draft, and to "water-steam" the green bricks with smaller loss than has heretofore been possible.

DISH-WASHER.—HIRAM H. TUTTLE, Washington, D. C. The dish-washer consists of a body in which a plunger moves, having a perforated bottom plate; a side or rim; and an upwardly projecting, perforated, tubular column having at its lower end an enlarged collecting-chamber in which water may be collected and forced up the column on the descending stroke of the plunger, the plunger being operated by a lever. The water, as it is discharged by the plunger through the perforated column, streams over the dishes lying within the casing of the apparatus.

Designs.

BAG-TIE.—WILLIAM M. CLARK, Boscobel, Wis. The leading feature of this design is found in an elongated loop-body, both members of which are open end being bent to form eyes. These eyes are carried in opposite directions, one eye having its terminal bent to form a hook.

MONUMENTS.—EDWIN O. TOWNSEND, New York city. The first of these designs consists of an altar-like body, surrounded by a stone cushion having battlement ornaments. The base of the altar, forming a surbase for the monument, is partially smooth and partially rough, and is also decorated by battlement ornaments. The second design has its leading features a sarcophagus; a surbase for the sarcophagus ornamented with molding and panels; and a plinth for the surbase, decorated by rough panels separated by plain surfaces.

COVERED DISH.—ADOLPHE PAROUTAUD, New York city. The characteristics of this design are a body of plain contour, flaring upwardly and outwardly; and a cover, having a scalloped, peripheral contour.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for 10 cents each. Please send the name of the patentee, title of the invention, and date of this paper.

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Notes & Queries

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References to former articles or answers should give date of paper and page or number of question.

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Minerals sent for examination should be distinctly marked or labeled.

(7540) B. N. L. asks: Will the zinc sold in the hardware store for use in the bell batteries answer to use in the plunge batteries illustrated in the SCIENTIFIC AMERICAN of August 31, 1889, that is, are they amalgamated as described? A. The zincs for bichromate battery should be flat plates as large as will slide freely into the glass cells, and about five-sixteenths inch thick. These plates can be purchased all ready for use, that is amalgamated, but it is easy to amalgamate them for yourself.

(7541) C. F. M. says: I would like to have a good receipt to make glue for tabbing note heads, etc. I want the kind that will enable one to reach into the middle of the tab, pull out a sheet and not disturb the remaining ones. A. The composition is said to be prepared as follows: Glue, 4 pounds; glycerine, 2 pounds; linseed oil, ½ pound; sugar, ¼ pound; aniline dyes, q. s. to color. The glue is softened by soaking it in a little cold water, then dissolved together with the sugar in the glycerine, by aid of heat over a water bath. To this the dyes are added, after which the oil is well stirred in. It is used hot. Another composition of a somewhat similar nature is prepared as follows: Glue, 1 pound; glycerine, 4 ounces; glucose sirup, about 2 tablespoonfuls; tannin, one-tenth ounce. Give the compositions an hour or more in which to dry or set before cutting or handling the pads.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Granted

DECEMBER 27, 1898,

AND EACH BEARING THAT DATE.

[See note at end of list about copies of these patents.]

Acid and making same, alkyl derivative of uric, E. Fischer.... 616,700
Acid, obtaining alkyl-uric, E. Fischer.... 616,656
Advertising device, E. Vedder.... 616,508
Air goods, A. A. Young.... 616,816
Alarm. See Skate alarm.
Alloy for soldering, H. Griffith, Jr., et al.... 616,613
Alloys of copper and iron, manufacture of, J. Burns.... 616,599
Armature coils, mould for forming, W. K. Bassford, Jr.... 616,519
Asphalt paving materials, portable apparatus for preparing, C. E. Foster.... 616,834
Automatic regulator, H. E. Hunt.... 616,842
Axle, vehicle, E. L. Peterson.... 616,686
Baby jumper, Cowles & Clemson.... 616,697
Bag holder and truck, combined, G. Anderson.... 616,443
Baking tin, Warner & Howe.... 616,510
Bale tie, S. M. Neely.... 616,552
Baling press, J. R. Fordyce.... 616,457
Baling press, H. J. Grimm.... 616,785
Balls, etc., machinery for gaging and sorting steel, Hall & Piercy.... 616,789
Bandage fabric, W. R. Cartledge.... 616,524
Barber's shears, M. G. Shain.... 616,639
Barrel cover, W. P. Burke.... 616,447
Barrel pitching machine, C. Kaestner.... 616,847
Bath apparatus, shower, A. S. Hills.... 616,668
Beer pressure regulator, C. Christian.... 616,604
Bell, bicycle, E. D. Rockwell.... 616,732
Belt placer and tightener, A. Luke.... 616.792
Bicycle, G. Harden.... 616.571
Bicycle, A. G. Mead.... 616,480
Bicycle, W. E. Nageborn.... 616,551
Bicycle frame, G. W. Miltimore.... 616,681
Bicycle gear, W. H. Symonds.... 616.744
Bicycle lock, G. Johnson.... 616,845
Bicycle pedal, R. H. Ramsey.... 616,489
Bicycle propulsion, W. E. Hartzell.... 616.665
Bicycle saddle, J. D. Hobbs.... 616,841
Bicycle support, C. H. Thurston.... 616,749
Blackboard, M. D. L. McCollum.... 616,799
Boiler. See Water tube boiler.
Boiler tester, L. Kaczander.... 616,539
Boot or shoe toe protector, R. S. Simister.... 616,810
Boring apparatus rods, lowering device for, A. Raky.... 616,586
Boring tool, T. Russell.... 616,496
Bottle, M. F. Hudson.... 616,710
Bottle closure, L. G. Flanigan.... 616,529
Bottle packing envelop, J. R. O'Reilly.... 616,583
Bottle stopper, L. H. Broome.... 616.598
Bottle truck and drainer, F. W. Schuster.... 616,737
Bottles, device for preventing refilling of, J. L. Adams.... 616,442
Box. See Cash box. Folding box. Hat box. Paper box. Service box. Wagon box. Work-box.
Box, Marsh & Leach.... 616,625
Box fastener, P. C. Leidich.... 616,624
Brake. See Wagon brake.
Brake shoe, J. D. Gallagher.... 616,568, 616,569
Brick, J. F. Booraem.... 616,652
Bridge, suspension, T. J. Hitson.... 616,536
Bridges, folding steps or stairs for lift, T. H. Williams.... 616,515
Brush for cleaning cycle chains, A. H. Stanbury, Jr.... 616,593
Brush, polishing, M. Leiner.... 616,677
Buckle and loop, Gelabert & Nelson.... 616,609
Burner. See Gas burner.
Burning compound and compounding same, E. Gumpoldt.... 616.838
Burning pulverized fuel, nozzle for, C. M. Day.... 616.455
Button, separable, F. K. Goff.... 616,461
Cabinet, braid, L. Sutro.... 616,505
Can. See Hermetically sealed can. Milk can. Sheet metal can.
Can lock, milk, Weitz & Berkebile.... 616,754
Candy machine, A. G. McCausland.... 616,723
Car door track, J. G. Lawler.... 616,476
Car, dumping, P. R. Grabill.... 616,663
Car, dumping, H. C. Williamson.... 616,693
Car fender, street, T. C. Forbes.... 616,701
Car mechanism, street, F. S. Pearson.... 616,585
Car, mining, A. Maxwell.... 616,793
Cars, mechanism for operating doors of hopper bottom, J. Simonton.... 616,811
Cars, steam distributing system for heating railway, J. R. Deisher.... 616.827
Carpet sweeper, C. King.... 616.870
Cartridge, J. Muthherr.... 616,721
Cash box or safe, E. Caron.... 616.767
Cash register, W. F. Bockhoff.... 616,866
Cash register and indicator printing attachment, E. B. Hess.... 616,708
Cask, aluminum, W. R. Taylor.... 616,563
Cask pitching apparatus, H. Rauch.... 616,632
Character recording device, Engle & Wedge.... 616,655
Check, tablet, W. E. Bowen.... 616.653
Chenille and chenille fabric, J. S. Templeton.... 616,748
Chilled rolls, method of and apparatus for making, F. Gorman.... 616.835
Churn power, J. M. Dorsey.... 616,830
Cigarette machine, R. Legg.... 616,477
Cleaner. See Hose cleaner. Window cleaner.
Clip. See Whiffletree clip.
Clothes line reel, F. B. Taylor.... 616.747
Clothes line window support, J. Gormley.... 616,784
Clothes reel, E. H. Larkin.... 616,676
Clutch mechanism, G. L. Reenstierna.... 616,729
Coating metallic sheets, process of and apparatus for, T. Rees.... 616,491
Coffee berries, apparatus for roasting, M. F. Hamsley.... 616.790
Coffee mill, M. Griswold, Jr.... 616.614
Cog wheel, H. O'Reilly.... 616,725
Colter, plow, G. J. Bransford.... 616,450
Combing machine frame, cotton, J. T. Meats.... 616.794
Compress, roller, J. R. Fordyce.... 616,777
Compressor or blowing engine, Helander & Lindroth.... 616.667
Conveyer, F. H. Richards.... 616,688
Copying press, O. J. Taeuber.... 616.745
Cord or tape, stiffening, Warren & Holden.... 616,645
Corset and fastening therefor, J. M. Steinhardt 616,503
Cotton gin, W. H. Baskin.... 616,761
Cotton gin, multiple, T. F. Hutchinson.... 616,466
Coupling. See Pipe coupling. Thill coupling.
Crate, collapsible folding, A. E. Anderson.... 616,445
Crate or coop, foldable, J. O. Moss.... 616,550
Crutch, R. Schwarting.... 616,738
Crystals, process of and apparatus for obtaining, J. Bock.... 616,821
Culinary vessel, A. C. Hertz.... 616,573
Cultivator, J. A. Gregory.... 616,837
Cutter, C. H. Churchill.... 616,825
Cutting machine, M. E. Card.... 616,823
Cycle driving gear, chainless, J. A. N. & C. B. H. Rasmussen.... 616,559
Cycle driving mechanism, G. G. M. Hardingham 616,534
Cycle hubs, apparatus for manufacturing, H. W. L. M. Bourke.... 616,764
Cycle lock, Dethlefsen & Feddersen.... 616,775
Dam for repairing breaks in levees, W. H. Schneider.... 616.690
Display cabinet, illuminated, F. A. Daly.... 616.826
Display holder for shoestrings, J. K. Gaines.... 616,657
Draught attachment, spring, McDaniel & Graves 616,684
Drawing roller, G. H. Sachsenroder.... 616,735
Dredging machine, G. F. Kretz.... 616,675
Dress waist, E. K. Warren.... 616,644
Drill. See Shoe drill.
Dropper. See Seed dropper.
Dye from gallocyanin and making same, blue, C. De La Harpe.... 616.622
Eaves trough hanger, J. W. Bell.... 616.446
Egg case machine, J. H. Batchelder.... 616,520
Electric cable, armored, E. T. Greenfield.... 616,612
Electric heater, J. F. E. McElroy.... 616,800
Electric motor and controlling same, C. W. Kennedy.... 616.673
Embalming and cooling board, H. A. Tozer.... 616.691
Embroidery machine, Eder & Stein.... 616.776
End gate fastener, S. A. Robinson.... 616,588
Engine. See Rag engine. Rotary engine.
Evaporator, H. B. Schulte.... 616.638
Exhauster, J. M. Seymour, Jr.... 616.590
Exposure meter, J. G. Baker.... 616,760
Extractor. See Spike or nail extractor.
Fabric. See Bandage fabric. Woven fabric.
Fan, motor, F. Lenzner.... 616.712
Fastener stud member, separable, G. E. Adams.... 616.758
Faucet, P. K. O'Lally.... 616,629
Faucet, measuring, L. H. Johnson.... 616.671
Fence, D. J. Jones.... 616,558
Fence, farm, Russell & Fentress.... 616,734
Fence, portable wire, J. W. Le Gore.... 616,544, 616,545
Fences, machine for weaving stay wires on wire, P. J. Wieland.... 616,514
Fender. See Car fender.
File, paper or bill, A. A. Reaser.... 616,490
Firearm sight, E. F. M. Wendelstadt.... 616,512
Folding box, J. A. Kingsley.... 616,848
Fuel washing and filtering appliance, G. W. Elliott.... 616,831
Furnace. See Smelting furnace.
Furnace, Snyder & Heitzman.... 616,742
Furnace charging apparatus, blast, F. C. Roberts 616.494
Furnace for heating billets, E. H. Carroll.... 616,602
Furnace or heater, C. D. Howard.... 616,844
Furnace smoke consumer attachment, W. H. Perley.... 616,727
Furnaces, hollow arch supporting standard or buckstay for zinc smelting, R. H. & W. Lanyon.... 616.474
Game board, W. W. Phares.... 616,557
Garment, A. Gartner.... 616,460
Gas burner, C. F. Cattell.... 616.453
Gas burner, E. J. Dolan.... 616,828
Gas burners, air regulating device for atmospheric, J. N. Webb.... 616,752
Gas burners, chimney holder for atmospheric, J. N. Webb.... 616,753
Gas burners, etc., for heating purposes, utilizing flames of, P. R. Wilde.... 616.564
Gas generator, acetylene, C. N. Lippitt.... 616,546
Gas generator, acetylene, J. A. Mosher.... 616.483
Gas regulator, safety, J. C. Reynolds.... 616,730
Gaseous products from dry distillation of wood, apparatus for extracting, A. Schmidt.... 616,637
Gear teeth, device for generating, O. J. Beale. 616.648, 616,649
Generator. See Gas generator. Steam generator.
Glass press, W. Haley.... 616,664
Glaziers' points, machine for making and driving, J. S. Carter.... 616,603
Gold leaf, paste composition for saving, F. H. Lewis.... 616.791
Grate, F. Wandel.... 616,595
Greenhouse gutter, G. M. Garland.... 616,781
Grinder, portable roller, F. W. Wright.... 616,597
Grist mill, J. R. Jones.... 616,469
Gun carriage, A. Resow.... 616,687
Gun, take down, W. Mason.... 616.719
Hair pin, C. A. Meldrum.... 616,680
Hams, etc., preserving, C. J. Dempsey.... 616,527
Handle. See Stamp handle.
Handle hand grip, F. Taylor.... 616.746
Harrow, W. M. Baker.... 616,817
Harrow, S. H. & D. Garst.... 616.530
Harvester and thrasher, combined, A. Gump.... 616,786
Hat body pouncing machine, G. F. Larkin.... 616,623
Hat box, knockdown, W. G. Haas.... 616,869
Hay stacker, R. E. McDaniel.... 616,581
Hay stacker, W. H. Ney.... 616,628
Heater. See Electric heater.
Hermetically sealed can and opener for same, Sloan & Barnes.... 616,740
Hides, skins, or leather, machine for treating, J. Hall.... 616.570
Hoop lug, D. C. Henny.... 616,535
Hoops, impelling device for bowling, J. D. Hefley 616,707
Hose cleaner, J. R. Cochran.... 616.696
Hub, vehicle wheel, J. W. Beard.... 616,650
Ice machine freezing tank, T. Shipley.... 616,640
Incandescent mantles, means for transporting Welsbach or other, S. Mason.... 616.548
Jar, A. J. Hartman.... 616.839
Jar and closure, D. L. Newcomb.... 616,553
Joint. See Tube joint.
Joints, composition for making tight, Redhead & Emmerson.... 616.560
Journal box lubricator, B. M. Steele.... 616.812
Knife. See Pocket knife.
Knitting machine, W. W. Burson.... 616,600, 616.601
Ladder and scaffold, combined, I. R. Bell.... 616.762
Lamp, acetylene gas, C. N. Lippitt.... 616,547
Lamp, acetylene gas generator, F. W. Hedgeland.... 616.464
Lamp, electric incandescent, Joel & Fanta.... 616.620
Lamp for miners, electrical safety, C. Francke.... 616.779
Lamp, incandescent vapor, R. L. Doran.... 616,829
Lamp socket and base, incandescent electric, C. Van Deventer.... 616,507
Lamps, lighting or extinguishing automatically incandescent electric, Cole & Kinsman.... 616,770
Lamps, support and take up device for cable suspended electric, J. H. Dorion.... 616.607
Land roller, M. A. Martindale.... 616,717
Latch and lock, gravity, C. E. Moats.... 616,626
Leather snipping machine, C. C. Rogers.... 616,733
Light. See Skylight.
Lock. See Bicycle lock. Can lock. Seal lock.
Lock, Vedder & Tressel.... 616,751
Locomotive boiler water heater, P. A. Kimburg.. 616,541
Lubricator. See Journal box lubricator.
Lubricator, G. Huber.... 616,670
Mail bag catcher and crane, S. R. Patten.... 616,556
Manure spreader, J. S. Kemp.... 616.621
Matrices, method of and means for making, C. Sears.... 616,562
Measuring instrument recording device, A. H. Hoyt.... 616,669
Mercerizing apparatus, H. David.... 616,606
Mercerizing machine, J. R. Hope.... 616,709
Metal cutting shears, V. E. Edwards.... 616,608
Meter. See Exposure meter.
Milk can, self measuring, C. H. Van Alstyne.... 616,594
Mill. See Coffee mill. Grist mill.
Moulding masse cuite, apparatus for, L. May.... 616,679
Motor. See Electric motor. Rotary motor. Tide motor. Wave motor.
Motor, Rossi & Ghiggeri.... 616,589
Mower and trimmer, convertible lawn, S. O. Johnson.... 616,846
Mowing machine finger and stationary blade, J. H. Randall.... 616,631
Multiplication, chart for facilitating operation of, H. P. Butler.... 616.523
Nail puller, Pearce & Walker.... 616.803
Necktie fastener, F. J. Callaghan.... 616.822
Non-conducting covering, R. H. Martin.... 616.479
Noodle cutting machine, E. V. Brake.... 616.449
Nozzle, J. Wright.... 616,757
Oil and water separator, J. C. Glenn.... 616.661
Oil tank, cabinet, W. A. Sexton.... 616.591
Oliver, Raiza & Souther.... 616.488
Package, germ proof, W. M. Kinnard.... 616,472

(Continued on page 14.)

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Packing, metallic, J. W. Dudley 616,867
Padlock, permutation, G. E. Woodward 616,647
Paper bag machine, C. V. Crist 616,605
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Paper cutting machine, J. F. McNutt 616,801
Paper pail, W. G. Haas 616,868
Paper, toilet, R. Scholich 616,739
Paper vessel, W. M. Kinnard 616,471
Pavements, construction of asphalt, J. L. Adams 616,759
Pegging machine, E. Duplessis 616,699
Photographic ornamentations on metal, etc., producing, T. Hausermann 616,706
Photographic printing frame, J. A. Lofstedt 616,577
Photographic shutter, Odquist & Fyfe 616,582
Pile fabrics, machinery for cutting weft, J. J. Mann 616,716
Pin. See Hair pin.
Pipe coupling, W. Love 616,578
Pipe covering, non-conducting, W. H. Seltzer 616,809
Pipe sections, machine for grooving or threading sheet metal, J. C. Gooding 616,783
Pistol, magazine, J. H. Wesson 616,692
Placket fastener, M. B. Miller 616,720
Planter attachment, corn, W. C. Meyer 616,795
Plow, reversible, A. Smith 616,741
Plow, sidehill, G. Gerow 616,533
Pocketbook, A. Reznicek 616,492
Pocket knife, E. Ruettgers 616,689
Power. See Churn power.
Press. See Baling press. Copying press. Glass press.
Printer's stick frame, H. Goldzier 616,782
Puller. See Nail puller.
Pulley for power transmission, J. C. Pratt 616,630
Pulp grinder, A. W. Priest 616,728
Pump, H. W. Kimes 616,849
Pump, centrifugal, W. Jennings 616,576
Pump, double acting, E. S. Barzee 616,819
Pump, rotary, P. K. Wood 616,646
Puzzle, O. B. Brann 616,765
Rag engine, J. Wanshoffer 616,517
Railway signaling device, F. M. Myers 616,722
Railway switch detector bar, D. & W. H. Grubl-key 616,703
Railway systems, underground electric, Chamberlain & Coleman 616,824
Railway wagon doors, apparatus for automatically locking, L. Gordon 616,611
Razor, J. F. O'Rourke 616,554
Razor, safety, J. Reichard 616,806, 616,807
Reel. See Clothes reel. Clothes line reel.
Refrigerator, H. Hall 616,705
Register. See Cash register.
Regulator. See Automatic regulator. Beer pressure regulator. Gas regulator.
Rein holder, W. R. Coon 616,525
Rein holder, S. F. Ettinger 616,832
Rein support, L. W. Arnold 616,694
Rock or ore breaker, A. J. & P. W. Gates 616,658
Rock or ore breaker, Gates & Copen 616,659
Roentgen or X rays, apparatus for making observations by means of, J. Wertheimer 616,513
Roller. See Drawing roller. Land roller.
Rolling tie plates, A. Morrison 616,798
Roof valleys, machine for making, C. A. Sturtevant 616,642
Rotary engine, W. O. Brown 616,522
Rotary engine, R. Bruce 616,766
Rotary engine, J. Goebring 616,662
Rotary engine, E. B. Tree 616,643
Rotary motor, G. Silvestri 616,592
Rudders, means for mounting, R. Runeberg 616,561
Sawmill dog, A. D. Lane 616,711
Saw sharpener, F. W. Robertson 616,587
Scale, computing, J. H. Swihart 616,743
Screw, jack, W. W. McAlpine 616,683
Screw machine, Burnham & Parker 616,654
Seal lock, P. B. Smith 616,499
Sealing and stamping device, envelop, S. Crane 616,772
Seed dropper, C. C. Chancey 616,768
Separator. See Oil and water separator.
Service box, I. C. Koehne 616,542
Sewers, etc., gate for, J. C. McGowan 616,486
Sharpener, scissors, W. C. Lynch 616,478
Shear blade, G. A. Gugel 616,704
Shears. See Barber's shears. Metal cutting shears.
Sheet metal can, E. Barrath 616,865
Shirt, S. Deutsch 616,698
Shoe drill, W. F. Hoyt 616,616
Shoe, rubber soled leather, J. E. Kennedy 616,470
Siphon delivery device for liquids, F. L. A. Riemann 616,731
Skate alarm, roller, J. A. Fougereau 616,458
Skate, road, J. Reinhard 616,802
Skate, roller, T. E. Daniels 616,773
Skylight, E. J. Hulse 616,617
Smelting furnace, zinc, R. H. & W. Lanyon 616,475
Smoke consumer, McDonald & Klock 616,485
Speed governor, automatic high, Loeper & Hausdorfer 616,678
Spike or nail extractor, Iverson & Reh 616,618
Spring support, J. A. Staples 616,502
Square and curve for cutting garments, combined, E. M. & J. L. Richardson 616,493
Stamp handle, E. E. Spencer 616,590
Stanchion, cattle, D. E. Darnell 616,454
Stand. See Toilet and wash stand.
Steam generator, J. M. A. Gerard 616,532
Steam generator, J. Lyall 616,715
Steering, hydraulic transmitter for, W. C. Williamson 616,756
Stopper. See Bottle stopper.
Stove deflector, A. Birkicht 616,521
Stove heating, A. Deadman 616,526
Stove or furnace, coal, J. Bond 616,651
Stove or range, A. R. Peale 616,726
Stovepipe shelf, W. Haas 616,788
Street sweeper, Palmer & Phelps 616,685
Submarine mining and exploration, apparatus for, C. Brown 616,567
Surgical instrument, G. E. Kelling 616,672
Switch. See Telephone gravity switch.
Tank. See Oil tank.
Telephone exchange, automatic, F. A. Lundquist et al 616,714
Telephone gravity switch, C. T. Mason 616,718
Telephonic or telegraphic instruments, binding post for electrical, J. A. Williams 616,755
Testing apparatus, W. C. McKeown 616,627
Thill coupling, A. Bixby 616,820
Thread holder, S. G. Sutphin 616,814
Thyroid glands and making same, product from, E. C. C. Stanford 616,501
Tide motor, S. H. Jones 616,467
Tie. See Bale tie.
Tie plates, manufacture of, A. Morrison 616,797
Tire, J. C. H. Bagger 616,818
Tire for vehicle wheels, cushion, Fagan & Stoebler 616,833
Tire, pneumatic, K. G. Hiller 616,574
Tire, pneumatic, J. T. Wilson 616,516
Tire puncture plugger, bicycle, C. P. Gifford 616,660
Tire valve, pneumatic, R. L. Gibson 616,610
Tire valve, pneumatic, W. W. Orr 616,584
Tire valve, pneumatic, C. Tribuzio 616,750
Tire, wheel, J. J. Harden 616,462
Tires, cement injector for repairing pneumatic, W. Herrick 616,572
Tires, compound for closing punctures in pneumatic, J. Gaa 616,459
Tires, tool for loosening inner tubes of bicycle, Phelps & Brenner 616,487
Toilet and wash stand, T. Andrews 616,444
Tooth, artificial, T. S. Heineken 616,666
Tooth crowns, attaching, M. Tresenreiter 616,815
Towing machine, J. A. Mumford 616,580
Toy cue, R. C. Moore 616,482
Transport or conveyance of materials, F. Honigmann 616,537
Trolley carrier, W. J. Sumner 616,813
Trousers guard, A. Poulsen 616,558
Trousers, knickerbocker, F. A. Tawa 616,506
Tube for cycle construction, etc., W. Wilkinson. 616,596
Tube joint, J. J. Ricketts 616,808
Turbine, low speed high pressure water, C. Steiner 616,641
Twister stop motion, J. P. O'Connell 616,850
Typewriter, C. W. Brown 616,451
Typewriter reverse feed, T. A. Maulsby 616,549
Typewriting machine, F. W. Hillard 616,840
Typewriting machine, G. B. Webb 616,511
Umbrella attachment, F. Searle 616,736
Umbrella holder, Paddock & Freeborn 616,555
Valve, J. & W. H. Jamer 616,575
Valve, D. Lamond 616,543
Valve, C. B. Mitchell 616,796
Valve, Mohun & Clark 616,682
Valve, cylindrical balanced gate, T. A. Noble 616,724
Valve, inflation, J. H. Goss 616,836
Vehicle attachment, M. J. F. Scanlan 616,636
Vehicle, road, G. B. Schoepf 616,497
Vehicle standard, J. F. Cook 616,771
Vehicle storm apron, A. F. Brandenburg 616,566
Vehicle wheel, J. A. Heany 616,463
Vehicle wheels off car tracks, device for assisting, Fritzius & Marks 616,702
Velocipede, W. James 616,619
Velocipede, R. Miehle 616,481
Velocipede driving gear, T. Hann et al 616,674
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Water tube boiler, vertical, F. G. Gasche.......... 616,531
Wave motor, F. J. Hagen.......................... 616,615
Wave motor, S. H. Jones.......................... 616,468
Weather strip, D. W. Bosley....................... 616,695
Weaving double plush fabrics, double acting jacquard machine for, E. Claviez.................. 616,769
Weighing machine, J. Christiansen................ 616,852
Weighing machine, F. H. Richards..616,634, 616,635, 616,854, 616,855, 616,857 to 616,859, 616,862, 616,863
Weighing machine, F. E. Thompson............... 616,851
Weighing machine, automatic, F. H. Richards... 616,633
Weighing machine, automatic, J. Christiansen... 616,853
Weighing machine, automatic, F. H. Richards, 616,856, 616,860, 616,861, 616,864
Whalebone, artificial, W. A. C. Hunkemoller...... 616,465
Wheel. See Cog wheel. Vehicle wheel.
Whiffletree clip, J. Reed.....................616,804, 616,805
Wind motors, pumps, etc., pneumatic governor for, Edgerton & Roberts.......................... 616,456
Window, E. Myers................................. 616,484
Window cleaner, H. Stewart....................... 616,504
Wire fastener, W. F. Schroeder.................. 616,498
Wire, mould for shaping coiled, W. K. Bassford, Jr.. 616,518
Wire tightener and staple puller, combined, M. W. Gunn.. 616,787
Wool, hair, etc., machine for shearing, cutting, or clipping, F. Burgon........................ 616,448
Work box, Belville & Oltmer...................... 616,763
Woven fabric, J. C. Davis........................ 616,774
Wrench, W. King.................................. 616,540
Wrench, double grip sliding jaw, J. J. A. Miller.. 616,579

DESIGNS.

Badge, H. P. Stone.............................. 29,863
Badge or similar article, W. Heeren.............. 29,864
Bath ring, shower, L. Cline....................... 29,901
Bracket, Gillespie & Hughel...................... 29,885
Brush, G. R. Fox................................. 29,883
Cabinet, kitchen, D. E. Wiseman.................. 29,887
Cake, corn, G. H. Cross.......................... 29,882
Candlestick, Miller & Bodker..................... 29,877
Chafing dish stand, L. Wojidkow.................. 29,879
Coat hanger, J. E. Kennedy 29,872
Cyclometer case, G. B. Bassett................... 29,869
Egg beater handle, T. W. Brown................... 29,873
Eyeglass case, H. E. Guyer....................... 29,867
Fabric, W. H. Mayer.............................. 29,915
Fork crown, P. S. Reid........................... 29,874
Fulcrum post, C. W. Hart......................... 29,898
Glove or similar article, Lintner & Dowdall........ 29,910
Heaters, front plate for electric, E. E. Gold........ 29,891
Heating coil, R. H. Horne......................... 29,890
Heel plate, C. Rystrom 29,908
Horseshoe calk, Simonis & Lohrke.................. 29,896
Label, N. Witsch.................................. 29,865
Lamp casing, arc, R. Schefbauer................... 29,893
Lamp chimney, G. W. Blair......................... 29,881
Latch case, rim, H. R. Towne...................... 29,895
Mailing case, letter deposit, C. B. Gifford........... 29,888
Necktie, Carter & Holmes.......................... 29,911
Necktie fastener, A. H. Buell..................... 29,871
Pawl, gravity, C. L. Fowler....................... 29,902
Pitcher, H. Brunt................................. 29,878
Post, L. S. Flatau................................ 29,897
Powder pad, J. Marsden............................ 29,870
Puzzle board, B. H. Marshall...................... 29,906
Puzzle box, C. J. Staberg......................... 29,905
Railway splice bar, W. O. Nelson.................. 29,892
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Seam welting strip, F. W. Merrick................. 29,914
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Shoe, J. Harding.................................. 29,909
Spectacle or eyeglass temple, S. G. Marshutz...... 29,868
Spoon, I. B. Hooker............................... 29,866
Sprayer body, D. B. Smith................. 29,899, 29,900
Square, combination, B. E. Sawyer................. 29,875
Stand, ornamental, T. A. Knowlton................. 29,886
Staple extracting tools, member of, L. Vincent.... 29,903
Stove foot rail, L. Kahn.......................... 29,884
Teeth, cap for, Smith & McDowell.................. 29,876
Tile, roof, L. J. W. Birn......................... 29,904
Toy, combination, G. H. King...................... 29,907
Undergarment body, G. O. Cook..................... 29,912
Undervest, lady's, H. A. Taylor................... 29,913
Water bag, C. E. Longden.......................... 29,880

TRADE MARKS.

Antidote devoid of narcotic ingredients, fever, Swanson & Lloyd.............................. 32,288
Bakery products and confectionery, certain named, National Biscuit Company............ 32,301
Baking powder, Southern Manufacturing Company....................................... 32,300
Baking powder and bicarbonate of soda, Morehouse Manufacturing Company............... 32,299
Cigarettes, Egyptian Tobacco Company.....32,294, 32,295
Cigars, C. Hermanos Sucesores.................... 32,293
Cleansing fluid, C. G. Dobbs..................... 32,302
Condiments, certain named liquid, Horton Cato Manufacturing Company...................... 32,297
Consumption cure, Kalle & Company................ 32,287
Dress goods other than silk goods, Sweetser, Pembrook & Company.......................... 32,283
Foods prepared from wheat, cereal, M. A. Newmark & Company................................ 32,298
Gum, chewing, Smith & Woods...................... 32,291
Hair invigorator, N. V. Martin................... 32,290
Kaleidoscopes, G. Wale........................... 32,306
Matches made of pasteboard, Herzfelder & Frohlich.................................... 32,296
Naphtha or rock oil products, Naftalan-Gesellschaft, G. M. B. H........................... 32,304
Oil, kerosene, A. Kitson......................... 32,305
Perfumes for the breath, W. H. C. Burnett........ 32,292
Plows and their parts, Gale Manufacturing Company....................................... 32,307
Preparations for the skin, external and internal, L. M. Gilling................................ 32,289
Remedies for nervous diseases and general debility in liquid or tablet form, Bar-Ben Remedies Company................................. 32,285
Remedies for the minor inflammatory diseases of the eye, Hance Brothers & While............. 32,286
Soap, scouring, C. O. Strutz..................... 32,303
Suspenders, Rockford Suspender Company........... 32,284

PRINTS.

"The Best Flag," "The Best Bird," "The Best Goods on Earth," for ranges and heaters, Magee Furnace Company..................................... 92

LABELS.

"Bell's Flour," for flour, S. Bell & Sons............ 6,755
"Cereal Pancake Flour," for pancake flour, Cream Cereal Company............................. 6,756
"Gold Lion Cocktails," for cocktails, Cook & Bernheimer Company............................. 6,758
"Koke," for a chemical compound, W. L. Bitting.. 6,752
"Kremonia Better than Ammonia," for cleaning compound, Zucker & Levett & Loeb Company.. 6,754
"Pathfinder," for cigars, American Lithographic Company..................................... 6,757
"The Globe Match," for match boxes or cartons, Globe Match Company....................6,759, 6,760
"Vena-Cura," for varicose veins, A. C. Buttolph.. 6,753

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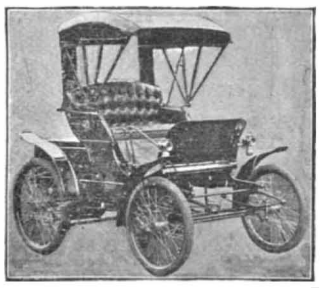

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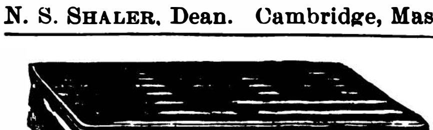

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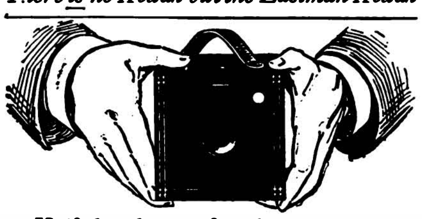

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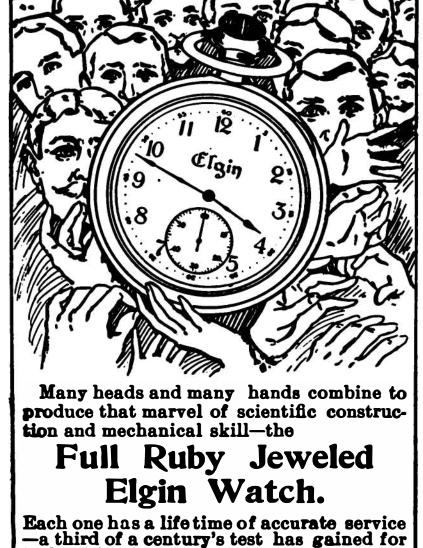

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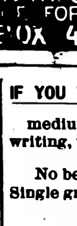

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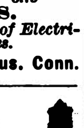

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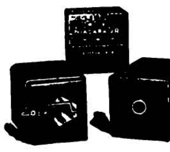

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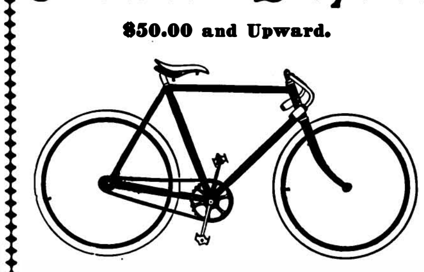

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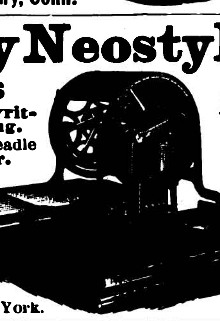

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